ARCADIS U.S., Inc.
7550 Teague Road, Suite 210
Hanover, MD 21076
www.arcadis-us.com

Ms. Sharon Hartzell
U.S. Environmental Protection Agency
290 Broadway, 18th Floor
New York, NY 10007-1866

Mr. Scott Vondy
New Jersey Department of Environmental Protection
Division of Responsible Party Site Remediation
401 East State Street, Floor 5
Trenton, New Jersey 08625-0028

Environment

Subject:
Draft Final QAPP Addendum for Picatinny Arsenal, New Jersey
Contract No: W912DR-18-D-0004
Delivery Order No: W912DR18F0685

Date:
18 October 2019

Contact:
Lisa Szegedi

Phone:
201-398-4328

Email:
Lisa.Szegedi@arcadis-us.com

Our ref:
30001976

Dear Ms. Hartzwell and Mr. Vondy,

Arcadis U.S., Inc. is pleased to provide the Draft Final QAPP Addendum for per- and polyfluoroalkyl substances at Picatinny Arsenal, New Jersey. Please review and provide comments by 1 November 2019.

Please call Lisa Szegedi at 201-398-4328 if you have any questions or comments.

Respectfully,

Arcadis U.S., Inc.

Michael Murphy
Arcadis U.S., Inc.

Copies:

Kent Gonser, USAEC
Laurie Haines-Eklund, USAEC
Hector Anchondo, USAEC
Riadh Hossain, USACE
Clifford Opdyke, USACE
Brant Crumbling, USACE
Mary Ellen Maly, USAEC ESM
Ted Gabel, Picatinny
Michelle Daly, ENVRG
Rhonda Stone, Arcadis
Kimmie Schrupp, Arcadis
Eric Killenbeck, Arcadis

DEPARTMENT OF THE ARMY
INSTALLATION MANAGEMENT COMMAND
HEADQUARTERS, UNITED STATES ARMY GARRISON, PICATINNY
PICATINNY ARSENAL, NEW JERSEY 07806-5000

October 17, 2019

REPLY TO ATTENTION OF
Environmental Affairs Division

SUBJECT: Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)/Interagency Agreement (IAG) Administrative Docket No. II-CERCLA-FFA-001-04: Submittal of the ***"Uniform Federal Policy-Quality Assurance Project Plan Addendum USAEC Per- and Polyfluoroalkyl Substances Preliminary Assessment/Site Inspection Picatinny Arsenal, New Jersey*** or the ***"SI QAPP"***

Ms. Sharon Hartzell
U.S. Environmental Protection Agency
290 Broadway, 18th Floor
New York, NY 10007-1866

Mr. Scott Vondy
New Jersey Department of Environmental Protection
Division of Responsible Party Site Remediation
401 East State Street, Floor 5
Trenton, New Jersey 08625-0028

Ms. Hartzell and Mr. Vondy:

Enclosed for your reviews are copies of the ***"SI QAPP"*** developed by Arcadis and approved by the Army technical team. As per the September 19th conference call, we request that your reviews be completed within the 2 weeks. Sampling is planned for early November.

Note 1: The primary project goal of this SI is to determine the presence or absence of PFAS at AOPIs. Briefly, presence is defined by this document as an analytical result for any parameter above its detection levels. However, this presence-absence determination should not be mistaken for the criteria for the determination why any AOPI will require further investigations (i.e. a CERCLA RI.) That criteria will be made after the SI result are validated will then be based on then-current guidance and/or current practice.

Note 2: This SI QAPP contains information related to the southern boundary Off-Site drinking water investigation as required by the contract. I suggest you read it for informational purposes rather than comment or approval. Approval should be directed to the proposed on-site AOPI investigation.

Note 3: The Army has determined that three AOPIs: the Former Pyrotechnic Area, Former Building 24 and Firehouse 1 will go into RI phase based on the 2018 sampling results. No samples for these AOPIs will be collected for this effort. This was not fully discussed during the conference call as I understand.

Sincerely,

Ted Gabel, Project Manager for
Environmental Restoration

Enclosure
Cc: Jim Kealy, NJDEP

DRAFT FINAL

Uniform Federal Policy-Quality Assurance Project Plan Addendum

USAEC Per- and Polyfluoroalkyl Substances Preliminary Assessment/Site Inspection Picatinny Arsenal, New Jersey

October 2019

Contract: W912DR-18-D-0004
Delivery Order: W912DR18F0685

Prepared For:

U.S. ARMY CORPS OF ENGINEERS, BALTIMORE DISTRICT
2 Hopkins Plaza
Baltimore, Maryland 21201-2536

U.S. ARMY ENVIRONMENTAL COMMAND
2450 Connell Road, Bldg. 2264
Fort Sam Houston, Texas 78234

PICATINNY ARSENAL
Rockaway Township
Morris County, New Jersey

Prepared By:

ARCADIS U.S., INC.
7550 Teague Road, Suite 210
Hanover, MD 21076

Uniform Federal Policy-Quality Assurance Project Plan Addendum

USAEC PFAS SI
Picatinny Arsenal, New Jersey

Prepared for:
US Army Corps of Engineers
Contract: W912DR-18-D-0004
Delivery Order: W912DR18F0685

Prepared by:
Arcadis, Inc.
7550 Teague Road, Suite 210
Hanover MD 21076

Our Ref.:
30001976.
Date:
October 2019

Lisa Szegedi
Project Manager and Regional Lead

Eric Killenbeck
Site Hydrogeologist

CONTENTS

Introduction 1

QAPP Addendum Worksheet #1 & #2: Title and Approval Page 2

QAPP Addendum Worksheet #4, #7, & #8: Personnel Qualifications and Sign-off Sheet 3

QAPP Addendum Worksheet #10: Conceptual Site Model 5

QAPP Addendum Worksheet #11: Project/Data Quality Objectives 15

QAPP Addendum Worksheet #13: Secondary Data Uses and Limitations 18

QAPP Addendum Worksheet #14 & #16: Project Tasks & Schedule 19

QAPP Addendum Worksheet #15: Reference Limits and Evaluation Tables 21

QAPP Addendum Worksheet #17: Sampling Design and Rationale 27

QAPP Addendum Worksheet #18: Sampling Locations and Methods 31

QAPP Addendum Worksheet #20: Field QC Summary 41

References 43

Figures

Figure 1. Picatinny Arsenal Location

Figure 2. Site Layout with Generalized Groundwater and Surface Water Flow Directions

Figure 3. AOPI Locations

Figure 4. Pre-SI Sampling Former Pyrotechnic Area and Sanitary Landfill, Former Burning Grounds, and Southern Boundary

Figure 5. Pre-SI Sampling Former Buildging 24

Figure 6. Pre-SI Sampling Building 169 - Firehouse 1

Figure 7. Pre-SI Sampling Former WWTP

Figure 8. CSM Former Pyrotechnic Area

Figure 9. CSM Former Lower Burning Ground

Figure 10. CSM Former Building 24

Figure 11. CSM Building 169 Firehouse 1

Figure 12. CSM Former WWTP

Figure 13. CSM Post Farm Landfill

Figure 14. CSM Building 3316 Firehouse 2

Figure 15. CSM Lawn N of Building 3409/3410

Figure 16. CSM Area 1222 Gorge
Figure 17. CSM Building 3801 – NJARNG Helipad
Figure 18. Off-Site Well Locations
Figure 19. Community Well Head Protection Areas
Figure 20. Former Pyrotechnic Area
Figure 21. AOPI Former Building 24
Figure 22. AOPI Building 169 – Firehouse 1
Figure 23. Proposed Sampling – AOPI Former Lower Burning Grounds and Sanitary Landfill
Figure 24. Proposed Sampling – AOPI Former WWTP Facility
Figure 25. Proposed Sampling – AOPI Post Farm Landfill
Figure 26. Proposed Sampling – AOPI Building 3316 – Firehouse 2
Figure 27. Proposed Sampling – AOPI Lawn to the North of Building 3409/3410
Figure 28. Proposed Sampling – AOPI Building 3801 - NJARNG Helipad Area
Figure 29. Proposed Sampling – AOPI Area 1222 - Gorge
Figure 30. Proposed Sampling – Eastern Boundary On-Site
Figure 31. Proposed Sampling – Northern Boundary On-Site
Figure 32. Proposed Sampling – Mid-Valley Upgradient On-Site
Figure 33. Proposed Sampling – Site-Wide Surface Water Samples

Attachments

Attachment 1. Off-Site Well Details
Attachment 2: Off-Site Well Logs
Attachment 3. Site Safety and Health Plan (provided under separate cover)
Attachment 4: Off-Site Well Sampling SOP
Attachment 5: Example Off-Site Property Owner Letters

List of Acronyms and Abbreviations

°F	degrees Fahrenheit
%	percent
AFFF	aqueous film-forming foam
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	United States Army
bgs	below ground surface
B.S.	Bachelor of Science
CFR	Code of Federal Regulations
CP	Building 24 Chromium Plating
CPR	cardiopulmonary resuscitation
CSM	conceptual site model
DoD	Department of Defense
DPT	direct-push technology
DQO	data quality objective
EAB	Eastern Boundary
ELLE	Eurofins Lancaster Laboratories Environmental
EB	equipment blank
FB	field blank
FD	field duplicate
FH1	Building 169 – Firehouse 1
FH2	Building 3316 – Firehouse 2
ft bgs	feet below ground surface
GPB	Green Pond Brook
HAL	Health Advisory Level
HEL	NJARNG Helipad
GPS	global positioning system
GRG	Area 1222 Gorge
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	investigation-derived waste
installation	U.S. Army and Reserve installation
IRP	Installation Restoration Program
LAW	Lawn N of Building 3409/3410
LC/MS-MS	liquid chromatography / tandem mass spectrometry
LOD	limit of detection
LOQ	limit of quantitation
M.S.	Master of Science
MS	matrix spike
MSD	matrix spike duplicate
MW	monitoring well
MVU	MidValley Upgradient
N	normal (parent)
NJARNG	New Jersey Army National Guard
NJDEP	New Jersey Department of Environmental Protection
NAB	Northern Boundary

List of Acronyms and Abbreviations

N/A	not applicable
ng/g	nanogram per gram
ng/L	nanogram per liter
NS	no sample
OSHA	Occupational Safety and Health Administration
PA	preliminary assessment
PFAS	per- and polyfluoroalkyl substances
PFL	Post Farm Landfill
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PICA	Picatinny Arsenal
POC	point of contact
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
PSL	Former Pyrotechnic Area and Sanitary Landfill
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RI	Remedial Investigation
SAB	Southern Boundary
SI	site inspection
SO	soil
SOP	standard operating procedure
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SW	surface water
TBD	to be determined
TGI	technical guidance instructions
TOC	total organic carbon
U.S.	United States
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
WTP	Water treatment plant
WWTP	Wastewater Treatment Plant

120

INTRODUCTION

A Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP; Arcadis U.S., Inc. [Arcadis] 2018b) was developed and submitted as final in October 2018. The PQAPP addresses the per- and polyfluoroalkyl substances (PFAS) preliminary assessment (PA) and site inspection (SI)-phase sampling at active United States (U.S.) Army (Army) installations (installations) within the U.S. Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) are two of the most abundant PFAS and are recognized by the United States Environmental Protection Agency (USEPA) as contaminants of emerging concern that present potentially unacceptable human health and environmental impacts. The purpose of this site-specific Quality Assurance Project Plan (QAPP) Addendum is to supplement the PQAPP, detail the planning processes for collecting data, and describe the implementation of the quality assurance (QA) and quality control (QC) activities developed for the SI sampling proposed at Picatinny Arsenal (PICA) in Rockaway, New Jersey. The objectives of the PQAPP and this QAPP Addendum are to generate project data that are technically defensible and useful in meeting the Army's PFAS SI project goals. Project goals include identifying the presence or absence of PFAS (including PFOS and PFOA) at areas of potential interest (AOPIs), identifying the presence or absence and the nature of other PFAS, and updating AOPI drinking water conceptual site models (CSMs), which will be detailed in an SI Report.

This QAPP Addendum addresses three primary elements:

- Project management
- General CSM description
- Site-specific investigation design and data acquisition.

The site-specific worksheets in this QAPP Addendum for PICA supplement the general programmatic information provided in the PQAPP. Site-specific details provided in this QAPP Addendum include sampling locations, media, methodologies, and procedures. Should site conditions warrant deviation from the perscribed procedures in this QAPP Addendum, the stakeholders will be consulted before changes to the sampling plan are made, and a revised QAPP Addendum will be issued, if necessary.

QAPP ADDENDUM WORKSHEET #1 & #2: TITLE AND APPROVAL PAGE

(Uniform Federal Policy-Quality Assurance Project Plan [UFP-QAPP] Manual Section 2.1)
(USEPA 2106-G-05 Section 2.2.1)

1. Project Identifying Information:
   - Site name/project name: U.S. Army Environmental Command (USAEC) PFAS SI
   - Site location/number: Picatinny Arsenal, Rockaway Township, New Jersey
   - Contract/work assignment number: W912DR-18-D-0004/ W912DR18F0685
2. Lead Organizations: United States Army Corp of Engineers (USACE), USAEC, and PICA
   - USACE Regional Point of Contact (POC), Baltimore District

     Electronic approval provided via email 10/16/19 – see worksheet #4

     Brant Crumbling Date
   - PICA USAEC Environmental Support Manager

     Electronic approval provided via email 10/15/19 – see worksheet #4

     Mary Ellen Maly Date
   - PICA Installation Restoration Program (IRP) Manager

     Electronic approval provided via email 10/15/19 – see worksheet #4

     Ted Gabel Date
3. List plans and reports from previous investigations relevant to this project:

Title	Date
Final Programmatic Uniform Federal Policy-Quality Assurance Project Plan, USAEC PFAS SI, Active Army Installations, Nationwide, USA	October 2018
Preliminary Assessment of Per- and Polyfluoroalkyl Substances, Picatinny Arsenal, NJ	February 2019

QAPP ADDENDUM WORKSHEET #4, #7, & #8: PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

(UFP-QAPP Manual Sections 2.3.2 – 2.3.4)
(USEPA 2106-G-05 Sections 2.2.1 and 2.2.7)

This worksheet is used to identify key site-specific personnel for each organization performing tasks defined in this QAPP Addendum.

LEAD ORGANIZATIONS: USACE, USAEC, and PICA

Name	Agency	Project Title/Role	Signature[1] (check box)
Brant Crumbling	USACE	Regional POC	☒
Mary Ellen Maly	USAEC	Environmental Support Manager	☒
Ted Gabel	PICA	IRP Manager	☒

ORGANIZATION: Arcadis

Name	Project Title/Role[1]	Education/Experience	Specialized Training/Certifications	Signature[2] (check box)
Lisa Szegedi	PICA Project Manager	Bachelor of Science (B.S.) and Master of Science (M.S.) in Environmental Science, Project Manager with over 25 years of experience managing a diverse array of multi-million-dollar hazardous waste projects under various programs including Superfund and USACE contracts.		☒
Jeff Burdick	Technical Lead	B.S. Geology, M.S. Hydrogeology 26 years of experience. Global lead for Site Evaluation and Restoration; site characterization, North American Technical PFAS Lead.		☒
Eric Killenbeck	Hydrogeologist	B.S. Geology, 20 years of experience. Technical expert in site characterization for both federal and private sector clients.		☒

Name	Project Title/Role[1]	Education/Experience	Specialized Training/Certifications	Signature[2] (check box)
Chris Goldsmith	Field Team Leader / Site Safety and Health Officer (SSHO)	B.S. Geology, 13 years of experience. Experienced Field Team Leader responsible for implementation of tasks performed as part of a given field event for both federal and private sector clients. Provides oversight of all safety activities related to the field tasks.	• Occupational Safety and Health Administration (OSHA): Initial 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) • OSHA: HAZWOPER 8-Hour Refresher 29 Code of Federal Regulations (CFR) 1910.120(e)(8) • First Aid/Cardiopulmonary Resuscitation (CPR) • OSHA 30-Hour Construction Safety	☒
Veronica Bean	Field Sample Management	B.S. Environmental Science, 14 years of experience. Provided sample management support on numerous federal and private sector clients. Has extensive experience with sample management for high volume sample projects.	• OSHA: Initial 40-Hour HAZWOPER • OSHA: HAZWOPER 8-Hour Refresher 29 CFR 1910.120(e)(8) • First Aid/CPR • Department of Transportation	☒

[1] Field sampling personnel may be subject to change based on staff availability.
[2] Signature check boxes indicate personnel have read and agree to implement this QAPP Addendum as written.

QAPP ADDENDUM WORKSHEET #10: CONCEPTUAL SITE MODEL

(UFP-QAPP Manual Section 2.5.2)
(USEPA 2106-G-05 Section 2.2.5)

Preliminary drinking water CSMs for PICA AOPIs included in the SI sampling scope of work are presented below. Data collected during the completion of the SI sampling scope of work within this QAPP Addendum will be used to further develop drinking water CSMs for each AOPI in the SI Report for PICA.

Background Information

PICA, which covers approximately 5,801 acres, contains both improved and unimproved lands and is located in Rockaway Township, Morris County, New Jersey approximately 45 miles west of New York City. The installation is bordered by numerous major highways including State Route 15, Interstate 80, and U.S. Route 46 (**Figure 1**).

PICA was established in the late 1800s as a storage and powder depot. Production activities began several years before the Spanish-American War, which started in 1898. At the beginning of World War I, PICA was manufacturing smokeless powder and munitions of various sizes. By the end of the war, PICA had begun new operations including the melt-loading of projectiles, manufacture of pyrotechnic signals and flares, experimental manufacture of modern propellants, high explosives, fuzes, metal components, and the loading of trinitrotoluene and amatol into bombs and projectiles. During World War II, PICA produced thousands of pounds of smokeless powder, boosters, primers, and detonators. PICA also produced thousands of pounds of explosives for the Korean and Vietnam Conflicts.

In recent years, PICA's mission has shifted to become an integrated weapons and armaments specialty site for guns and ammunition. To help support this mission, PICA is the site of the Armaments Research, Development and Engineering Center, whose mission is conducting and managing research and development for all assigned weapons systems. PICA has also established several partnerships with academia and industry and has involved them in the research and development process.

Physical Setting

Topography and Climate

PICA is located in the New Jersey Highlands physiographic province between the Appalachian Piedmont physiographic province to the southeast and the Valley and Ridge province to the northwest. The New Jersey Highlands Region is part of the larger New York-New Jersey Highlands that encompasses 1.1 million acres of Appalachian ridges and valleys stretching from the Hudson to the Delaware River.

The majority of PICA appears on the Dover U.S. Geologic Survey topographic quadrangle. Elevations on PICA range from 685 feet above mean sea level in the valley to 1,287 feet above mean sea level along the ridgeline of Green Pond Mountain. In general, elevations are lower to the south and east and higher to the north and west. The majority of PICA occupies a central valley (Picatinny Valley) that is approximately seven miles long along with a narrower parallel intermontane valley (Green Pond Gorge) that is about two miles long. The width of PICA is approximately one mile with Green Pond Mountain to the northwest of PICA and Copperas Mountain to the east, and an unnamed hill to the southeast. Overall, the dominant

topographic gradient is from the northeast to the southwest with severe slopes present along the northwestern boundary of PICA along Green Pond Mountain.

PICA has a cool, humid continental climate. The average annual high temperature is 58.0 degrees Fahrenheit (°F) with an average annual low temperature of 37.8 °F. Daytime high temperatures average from 30 °F in January to 80 °F in July. Average humidity during the year is 79 percent (%) with highs observed up to 100% and lows of 49% (Weather Underground, Inc. 2013). Average annual precipitation is 52.39 inches with monthly averages between 0 and 6.6 inches.

Geology and Hydrogeology

PICA is located in the New Jersey Highlands physiographic province geographic region. The New Jersey Highlands are composed of Proterozoic to Devonian rocks as part of the Appalachian Mountains and formed when the continents collided. The region consists of a complex system of folded and faulted bedrock that forms northeast to southwest trending valleys and ridges. PICA occupies a main central valley with four bedrock formations that form the valley and the surrounding ridges: Precambrian gneiss and other metamorphic rocks, Cambrian Hardyston quartzite, Cambrian Leithsville dolomite, and Silurian Green Pond conglomerate. Unconsolidated deposits consists of Pleistocene glacial till and stratified drift that overlie much of the bedrock formations with the thickest deposits occurring within the central valley of PICA, which consists mainly of stratified drift with till along the ridges (Lucey 1972).

The soils at PICA are acidic and primarily derived from glacial deposits. The central portion of PICA has soils that consist of loamy, silty, and gravel clay pan soils along with swampy areas that consist of peat and muck. The southern end of PICA consists of poorly sorted sands, gravels, and boulders bordered by a terminal moraine. To the northwest is a mountain range (Green Pond Mountain) with rough, stony land that formed on jagged, rocky slopes. Glacial till blankets the western and eastern flanks of PICA. Up to 20 feet of glacial till consisting of sand, gravel, and boulders covers the western portion of PICA. The eastern portion of PICA consists of uniform glacial till with thicknesses ranging from 10 to 25 feet. The valley floor consists of till and drift from glacial lakes and streams with a thickness of up to 200 feet (Dames & Moore 1991).

Groundwater at PICA consists of four distinct aquifers; unconfined, upper semi-confined, lower semi-confined and bedrock aquifers. The uppermost aquifer is an unconfined aquifer consisting of stratified drift on top of fine sand and silt lake sediments and has a thickness of 20 to 35 feet (**Figure 2**). Groundwater in the unconfined aquifer generally flows toward surface water discharge areas, such as Green Pond Brook (GPB), Bear Swamp Brook, and Lake Picatinny. Two semi-confined glacial till aquifers (upper and lower) consisting primarily of sand and gravel underlie the upper most aquifer. The upper semi-confined aquifer is generally encountered in the southern half of the valley. The lower semi-confined aquifer occurs beneath the upper only in the central valley portion of this area. Groundwater flow direction in the semi-confined aquifers is generally down valley to the southwest and towards surface water discharge areas. Vertical flow is typically upward towards discharge areas except where affected by groundwater withdrawal wells. These three valley-fill aquifers (unconfined, upper semi-confined, and lower semi-confined) have a maximum thickness of approximately 175 feet.The bedrock aquifer consists of several formations dependent on location throughout PICA due to the folded and faulted nature of the New Jersey Highlands. The ridges consist of Green Pond Conglomerate along the western ridge of the installation and a suite of crystalline mesoproterozoic metamorphic rocks that makesup the eastern ridge. Valley areas of PICA consists of Green Pond Conglomerate and the crystalline bedrock north of Lake Picatinny, and the Leithsville Dolomite south of Lake Picatinny. In the southern portion of PICA the Leithsville Dolomite is separated from the semi-confined glacial till aquifer by weathered bedrock with a maximum thickness of 60 feet (Dames & Moore

1991). Groundwater flow in the bedrock is generally towards the central valley and surface water features; with local variation from the foliation and fractures faults that are present that can alter and control flow directions along fractures and fault planes.

Surface Water Hydrology

PICA lies within the recharge area of the New Jersey Watershed Management Area 6, the primary water supply for northern New Jersey. Surface water drains primarily from northeast to southwest with GPB serving as the primary drainage for PICA. GPB originates at a 500-acre spring-fed lake known as Green Pond, located adjacent to the northern border of PICA. All drainages at PICA empty into the Rockaway River, approximately one mile south and east of PICA. Rockaway River is the major tributary to the Boonton Reservoir, located approximately 17 miles downstream (southeast) of PICA, and used as the Jersey City water supply.

Main waterbodies within the installation include GPB, several unnamed small ponds, Bear Swamp Brook, Picatinny Lake and Lake Denmark. Approximately one mile south of PICA, GPB joins the Rockaway River. The Rockaway River flows east through the Boonton Reservoir before joining the Passaic River. Bear Swamp Brook joins GPB on the southern end of PICA. Ames Brook as well as the Hibernia Brook tributary flow off PICA exiting along the eastern boundary and join Lake Ames. Lake Denmark and Picatinny Lake are man-made features that collectively comprise 360 acres of open water. The lakes were constructed in the 1880s and are primarily used for industrial water supply and recreation.

Known or Suspected Contaminants and Sources

During the PA, 10 AOPIs were identified following review of site documents, interviews with site personnel, and site reconnaissance visits (**Figure 3)**. Groundwater samples were collected from five of these AOPIs under a pre-SI investigation; refer to the Previous PFAS Investigations section. Additional information regarding each of the AOPIs is listed in **Table 1**.

290
291

Table 1 – AOPI Descriptions

AOPI Name	Location on PICA	Description	Pre-SI Samples Collected?
Former Pyrotechnic Area	Southern Boundary	Prior to 1990, aqueous film-forming foam (AFFF) was utilized in this area once or twice a year by the PICA Fire Department to extinguish lingering fires on the peaty grounds associated with this area. In addition to confirmed AFFF use, historical landfilling activities at the sanitary landfill included dumping of sanitary waste, fly ash, ordnance, industrial wastes, and wastewater treatment plant (WWTP) sludge (refer to the Former WWTP Facility write-up). The Former Pyrotechnic Area consists of a marshy area that is relatively level, with a large pond located within the bounds of the site. There is a small building on site, as well as numerous MWs.	Yes; 3 monitoring well (MW) samples
Former Lower Burning Grounds	Southern Boundary	The PICA Fire Department used AFFF intermittently in this area to extinguish lingering fires due to difficulty associated with extinguishing fires on the peaty grounds in this area. The majority of these responses involving AFFF happened prior to the early 1990s. The Former Lower Burning Grounds consist of a flat, level field with peaty/organic materials present and marshy areas. Current use includes a solar farm.	Yes; 3 MW samples
Former Building 24	Southern	Chromium plating operations at Former Building 24 began in approximately 1942 and continued until about 1982. This was identified as an AOPI because certain mist suppressants used in chromium plating could contain PFAS. Former Building 24 and its associated lagoons have since been demolished and removed but were once the site of chromium plating operations and waste disposal at PICA. The Former Building 24 lot is now used as a parking lot. Building 25 still exists and borders the site. Bear Swamp Brook runs between where the associated lagoons were and the Former Building 24 lot. Where the lagoons were constructed is now a grassy/gravel surface that does not have a defined use.	Yes; 2 MW samples
Building 169 – Firehouse 1	Southern	Building 169 – Firehouse 1 is the most recently constructed firehouse currently utilized by the PICA Fire Department, built approximately 10 years ago. Over the past 10 years, an estimated 55 gallons of AFFF have been released during nozzle testing and hose cleanouts at this location. Firetrucks that stored AFFF were also washed and housed in the parking lots and internal bays at this firehouse. Current firehouse that includes a garage to house fire trucks as well as office/living space for Picatinny Fire Department personnel. Outside of Building 169 is an associated parking	Yes; 1 MW sample

AOPI Name	Location on PICA	Description	Pre-SI Samples Collected?
		lot for fire trucks and personnel vehicles. The site also includes a grassy lawn area.	
The Former WWTP Facility	Southern	This was identified as an AOPI due to the use of AFFF. Although the facility building was demolished in 2011, the Former WWTP Facility (former building 80) and the associated sludge beds could potentially be a secondary source of PFAS. The Former WWTP Facility consisted of the sewage treatment plant and its associated structures and sheds as well as the sludge drying bed and leach fields on the southern portion of the facility lot.	Yes; 2 MW samples
Post Farm Landfill	Southern Boundary	This was identified as an AOPI due to the relation to chromium plating wastes since drums found at the Post Farm Landfill came from Former Building 24, as well as other buildings. Beginning in the 1940s through 1979, the Post Farm Landfill received a variety of industrial waste generated at PICA, including fly ash, paint stripping wastes, phenols, and spent explosive laden hydraulic oils. In addition to the chromium plating-related wastes, spent hydraulic oils and paint sludges could potentially be a secondary source of PFAS. The Post Farm Landfill is surrounded by wooded vegetation and is located proximal to the southeastern installation boundary. The area is no longer an active landfill and does not have any current known uses.	No
Building 3316 – Firehouse 2	Eastern Boundary	Approximately 10 years ago, prior to the construction of Firehouse 1, Building 3316 – Firehouse 2 was historically used as the sole fire department at PICA. Building 3316 - Firehouse 2 still operates as an active firehouse and location of fire truck storage and fire department operations. Historical operations included fire truck storage and washing, AFFF handling and truck refilling operations, and nozzle testing. Building 3316 – Firehouse 2 consists of a stone/brick building used for office/living space for PICA Fire Department personnel. Also included in the building are multiple bays for firetruck and firefighting materials storage. There is a wraparound paved parking lot and an additional storage building behind the main firehouse. Small grassy areas and a longer lawn strip are east of the firehouse and its associated parking lots.	No
Lawn North of Building 3409/3410	Eastern Boundary	In the early 2010s, the Lawn to the North of Building 3409/3410 was used by the PICA Fire Department on multiple occasions as a location of AFFF training activities such as arc-training and nozzle testing. The area consists of a grassy lawn area to the north of Buildings 3409 and 3410. There is a gravel roadway that separates the lawn and a wooded area.	No

AOPI Name	Location on PICA	Description	Pre-SI Samples Collected?
		There are abandoned stormwater collection system structures within the grassy area.	
Building 3801 – NJARNG Helipad Area	Eastern Boundary	In 1988 or 1989, the PICA Fire Department utilized AFFF to respond to a fire that occurred on a concrete slab adjacent to Building 3801 at the New Jersey Army National Guard (NJARNG) Helipad area. The fire occurred due to a static electricity spark during a vehicle fueling operation. Approximately 20 gallons of AFFF were used to extinguish the fire. This site is operated by the NJARNG and consists of a building with office space and an attached garage to perform maintenance repairs. Other components of the site include a helipad south of the building, fuel aboveground storage tanks, large open storage lots, multiple stormwater drains in the parking lot and adjacent to the helipad, and grassy/lawn areas spread out between paved sections.	No
Area 1222 - Gorge	North-Central	Prior to 1988, the PICA Fire Department used AFFF periodically to extinguish fires that started due to the munitions testing activities that occurred in this area. AFFF was used due to the difficulty in extinguishing fires on the rocky topography associated with this area. The Area 1222 - Gorge is an operational range at PICA and contains training equipment/structures related to range missions. Within the Area 1222-Gorge there are sections of rocky topography, steep slopes, small streams, and wooded vegetation. There are some small ponded areas of water due to craters created from training activities.	No

292

Previous PFAS Investigations

In 2013, under the third Unregulated Contaminant Monitoring Regulation, PICA collected samples from the existing Building 1383 Water Treatment Plant (WTP). Samples were collected from the point of entry into the distribution system and were analyzed for various parameters, including PFOS and PFOA. Neither compound was detected; the limit of detection (LOD) was 40 and 20 nanograms per liter (ng/L) for PFOS and PFOA, respectively.

Because regulatory guidance levels for PFOS and PFOA decreased in May 2016, with the promulagation of USEPA's health advisory level (HAL), and laboratories are able to achieve increasingly lower detection limits, in 2018 PICA performed proactive PFOS and PFOA sampling from the existing WTP at Building 1383, operated by American Water, as well as from the on-post potable wells PW-131 and PW-302D. Each sampling location has been shown to contain combined PFOS and PFOA concentrations in pre-treated water above the HAL (70 ng/L). Water from these wells is currently being treated with carbon to remove PFOS/PFOA. To date, all samples collected post-treatement have been non-detect for PFOS and PFOA; the laboratory LOD is 5 ng/L for each compound. The pre-treatment results from the most recent PICA potable well sampling, which was conducted in July and August of 2019 are as follows:

A. PW-131 – 135.9 ng/L PFOS and 14.1 ng/L PFOA

B. PW-302D - 82 ng/L PFOS and 8.7 ng/L PFOA

In September 2018, a pre-SI investigation was conducted at the following AOPIs; Former Pyrotechnic Area, Former Lower Burning Ground, Building 169 – Firehouse 1, Former Building 24, and the Former WWTP facility. Samples were also collected downgradient of the AOPIs at the southern boundary of the installation. Altogether, 25 samples were collected; 24 groundwater samples and one surface water sample. Refer to **Table 2** and **Figures 4 - 7**. Concentrations above the HAL were detected in one groundwater sample from the Former Pyrotechnic Area AOPI and two groundwater and one surface water sample from the southern boundary.

Table 2 – Pre-SI Sampling Results

Sample Location	No. of Samples (Groundwater / Surface Water)	Maximum PFOS / PFOA Concentrations (ng/L)	Comments
Former Pyrotechnic Area	3 / 0	7.4 / 70	One MW, 20/24MW-8, had concentrations > HAL; this is an unconfined aquifer
Former Lower Burning Grounds	3 / 0	Non-Detect / 26	All results < HAL
Former Building 24	2 / 0	50 / 13	All results < HAL
Building 169 – Firehouse 1	1 / 0	46 / 21	All results < HAL
The Former WWTP Facility	2 / 0	6.7 / 8	All results < HAL
Southern Boundary	13 /1	Groundwater – 300 / 14 Surface Water – 130 / 13	Wells with concentrations > HAL included MW SB1-2; unconfined aquifer and MW SB3-2; lower semi-confined aquifer. The surface water sample was collected from GPB where it exits the installation

Potential Receptors and Contaminant Exposure Pathways

Potential receptors and contaminant exposure pathways for each of the installation's AOPIs are presented in the CSMs on **Figure 8 through Figure 17**. Based on the historical use of AFFF at the AOPIs, affected media are likely to consist of soil, groundwater, surface water, and/or sediment. Release and transport mechanisms include dissolution/desorption from soil to groundwater, runoff/dissolution/adsorption with surface water or stormwater, and adsorption/desorption between surface water and sediment. Human exposure pathways are shown as "potentially complete" or "incomplete" on the CSM figures; exposure pathways are only "complete" when the presence of PFAS in the exposure medium has been confirmed and there is no barrier to receptor exposure. Considering the Army's primary concern is for human exposure through direct ingestion of PFAS in drinking water, the remainder of this section focuses on the potential exposure pathways for only groundwater and surface water.

On-site drinking water wells with known PFOS/PFOA contamination in groundwater are currently being used to supply drinking water at the installation. These wells are being treated with carbon; after treatment PFOS/PFOA are not detected in the water. Other potential receptor pathways may include discharge to or recharge from groundwater to Lake Denmark, Picatinny Lake, or off-site via GPB. Note that Lake Denmark and Picatinny Lake are not used for drinking water.

As discussed under Previous PFAS Investigations, groundwater and surface water samples collected from monitoring wells at the southern boundary of PICA had concentrations above the HAL. Therefore, the following steps were conducted to determine if any potable wells, which are potential receptors, are located within 0.3 miles downgradient of the southern boundary of PICA.

1. A well search was conducted using New Jersey Department of Environmental Protection (NJDEP) well records.
2. Local water providers were contacted to determine what properties, if any, within the downgradient area are not known to be connected to public water.
3. Letters were sent to the owners of the properties identified as potentially having a private well. The letter included a questionnaire for the owners to complete and send back so the presence/absence of a private well could be determined.
4. If the questionnaire was not returned, a door-to-door survey was conducted and, if the owner was present, the presence/absence of a private well was confirmed.

Based on the well search results, one private well located within 0.3 mile downgradient of the southern boundary was sampled and PFOS/PFOA were detected. Therefore, the well search was expanded to an area 1-mile downgradient of PICA. Six additional properties known to have private wells and two properties potentially having a private well were identified within 1-mile downgradient of PICA. **Figure 18** shows the results of the well search, calling attention to those wells that are potentially potable and a possible source of exposure for human receptors. Note that this information will be continuously updated based on a review of records, ground truthing of the off-site wells and property owner correspondence responses. Details regarding these wells is given in **Attachment 1**. The well logs are given in **Attachment 2**. In addition, a community Wellhead Protection Area (**Figure 19**) is located on the southern portion of the installation.

Data Gaps

The following have not been determined and will be investigated as part of this SI:

Groundwater

- The presence/absence of PFAS at the following five AOPIs.
    - Building 3316 – Firehouse 2
    - Area 1222 – Gorge
    - Building 3801 – NJARNG Helipad Area
    - Lawn North of Building 3409/3410
    - Post Farm Landfill
- During the pre-SI limited groundwater sampling was conducted at the following AOPIs. Additional groundwater sampling is needed to confirm/refute the pre-SI results.
    - Former Lower Burning Grounds
    - Former WWTP Facility
- The NJDEP database has indicated the potential presence of private domestic wells located within 1 mile downgradient of the southern and eastern boundaries of PICA (i.e., downgradient of the AOPIs). Because the locations given in NJDEP's database are approximate, the exact locations of these wells are unknown and needed to be confirmed by other means. The well confirmation process included record review, township/borough potable well inquiries, potential well location ground truthing and potential well owner notification correspondence. The off-post potable water testing program is still underway and additional wells may be tested, if appropriate.
- While PFOS/PFOA was detected in groundwater at the downgradient southern boundary of the installation it is unknown if PFOS/PFOA has migrated off-site.
- Upgradient groundwater has not been sampled at PICA; therefore, it is not known if PFAS is coming onto PICA from off-post locations.

Soil

- Source strength of potential PFAS masses remaining in the soil beneath all AOPIs has not been documented.
- The purpose of sampling soil is to evaluate the potential for those media to be sources of PFAS to surface water and groundwater, as an influence to drinking water receptors, and not to evaluate direct contact with sediment or soil.

Surface Water

- Standing and/or running water is potentially present at the following AOPIs. Note that some streams at PICA are intermittent; the presence/absence of PFAS in surface water at these AOPIs is unknown.
    - Former Lower Burning Grounds
    - Former WWTP
    - Lawn to the North of Building 3409/3410
    - NJARNG Helipad Area
    - Area 1222 – Gorge
- Due to the distance to running water, the remaining AOPIs do not have a surface water pathway.
- PFOS/PFOA was detected in a surface water sample collected from the GPB at the installation's southern boundary.
- Upgradient surface water has not been sampled at PICA

For this sampling effort, CSM evaluations will focus on the elements applicable to the primary source and human receptors through an exposure pathway of direct ingestion of drinking water. Complete, potentially complete, and incomplete exposure pathways will be documented. While other potential exposure media will be sampled during this SI, the potential for human exposures to PFAS through non-drinking water pathways has not yet been established and may be evaluated at a future date if it is determined that those pathways warrant further consideration. **Figures 20 through 33** show the AOPIs; three AOPIs do not need additional sampling (Former Pyrotechnic Area, Former Building 24, and Building 169 – Firehouse 1) and will be addressed during the Remedial Investigation (RI). For the remaining AOPIs (Former Lower Burning Grounds, Former WWTP Facility, Post Farm Landfill, Building 3316 – Firehouse 2, Lawn North of Building 3409/3410, NJARNG Helipad, and Area 1222 – Gorge) the sample locations are shown on the figures. **Worksheet #17** of this QAPP Addendum provides the rationale and sampling design for the SI sampling

413 scope of work to address the above data gaps. **Worksheets #18** and **#20** of this QAPP Addendum list the
414 proposed sample identifications and required QC samples for each media type.

QAPP ADDENDUM WORKSHEET #11: PROJECT/DATA QUALITY OBJECTIVES

(UFP-QAPP Manual Section 2.6.1)
(USEPA 2106-G-05 Section 2.2.6)

This worksheet states the problem, identifies the goal of the study, identifies information inputs, defines boundaries of the sampling, develops the analytical approach, specifies performance or acceptance criteria, and identifies the developed plan for obtaining data in accordance with USEPA's 7-step data quality objective (DQO) process, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA 2006). This QAPP Addendum presents the selected investigation design and rationale in **Worksheet #17**, and the sampling summary in **Worksheets #18** and **#20**.

Step 1: State the Problem:
Known PFAS impacts to humans via drinking water exposure at PICA, which pose a potential risk to human health, may be related to suspected releases of PFAS on site. Initial findings of a PA have identified 10 AOPIs at the installation at which PFAS-impacted material may be primarily related to the use of AFFF in the area or the disposal of PFAS impacted material in the area, or the use of mist suppression potentially-containing AFFF during chromium plating operations. PFAS are resistant to degradation in the environment, and the zones of highest contaminant flux have not been identified. The location and extent of sources of PFAS in drinking water at PICA have not been determined. Because PFAS was reportedly used in fire fighting activities off-site, the potential contribution of off-installation sources of PFAS on the PICA property also needs to be determined.
Step 2: Identify the Goal of the Study:
PFOS and PFOA are two emerging contaminants in the class of PFAS that have drinking water HALs (USEPA 2016). The sampling activities as part of this SI for PICA will be conducted in conformance with Department of Defense (DoD) instructions 4715.07 (DoD 2013) and 4715.18 (DoD 2009) and the DoD Manual 4715.20 (DoD 2012); the DoD Instructions 4715.18 requires DoD components to respond to emerging contaminants like PFOS and PFOA. On-site groundwater is pumped and used for drinking water purposes at PICA. Two on site potable wells were sampled and found to contain PFOS and PFOA above the HAL. Therefore, the primary goals of the sampling activities are to compile sufficient information to determine whether media associated with individual AOPIs on the installation contain detectable levels of PFAS, determine the residual source strength of those media, and refine the AOPI drinking water CSMs. For the purpose of this evaluation, any detections greater than the laboratory LOD will result in identification of PFAS presence. Complete vertical and horizontal delineation of PFAS contamination in soil and groundwater at PICA will not be completed in this project phase. Analytical samples collected for analysis of PFAS will be analyzed for select PFAS constituents (including PFOS/PFOA), as listed in the tables for each media type on **Worksheet #15** of this QAPP Addendum. The nature and extent of follow-up investigations will be determined at a later date in coordination with applicable guidance and regulator input.

Step 3: Identify Information Inputs:
The data needed to accomplish the goals of the sampling activities for this project are as follows: • All information reviewed to date as part of the PA to identify the AOPIs, including historical use and personal accounts of historical activities, spill records, previous remedial actions completed, previous analytical data and validation packages • Observations made during the site reconnaissance and conference calls after site visits, and during the investigation • Condition of existing on-site monitoring wells proposed for sampling • Locations of off-site private and public water supply wells • Condition and use of off-site wells proposed for sampling • New analytical data from sampled media applicable to each AOPI, which may include groundwater, soil, and surface water which may be accomplished through sampling of existing monitoring wells, temporary well installation, soil boring advancement, or grab sample collection • Soil boring description logs that include detailed descriptions where soil borings are advanced. Sampling will be limited to areas where AFFF (which likely contained PFAS, including PFOS/PFOA) use is documented, where chromium plating was conducted, or areas that may have received PFAS-contaminated material. Parameters and analytical methods are identified in Worksheets #19 and #30 of the PQAPP. Field sample collection methods are summarized in **Worksheet #17** of this QAPP Addendum and in Worksheet #21 of the PQAPP.
Step 4: Define the Boundaries of the Sampling:
Analytical sample collection at PICA will be completed within or near the AOPIs listed in **Worksheet #10 Table 1.** The sampling design and rationale is further described in **Worksheet #17** for each AOPI. Tentative sample identifications for each medium and location to be sampled are listed on **Worksheet #18** of this QAPP Addendum and are shown on **Figures 21 through 33.** Geographic coordinates for the off-site sampling locations are listed in **Attachment 1**. Well construction details for the off-site wells to be sampled are included in **Attachment 2**, as available. Details for the on-site wells, where available, are included on the sampling figures.

423

Step 5: Develop the Analytic Approach:
Samples will be collected in accordance with the technical guidance instruction (TGI) and standard operating procedure (SOP) documents included as Appendix A to the PQAPP (Arcadis 2018b). The samples will be submitted for analysis to Eurofins Lancaster Laboratory Environmental (ELLE). Liquid chromatography/tandem mass spectrometry will be used to analyze samples for PFAS; **Worksheet #15** of this QAPP Addendum identifies the laboratory LODs for PFAS. The LOD is defined as "the lowest concentration for reliable reporting of a non-detect of a specific analyte in a specific medium with a specific method at 99 percent confidence" (DoD 2017) and will be used as the project screening levels for this SI. Project screening levels will only be used to identify presence or absence of PFAS (i.e., project screening levels are not utilized for risk-based comparisons which may relate to future remedial decisions) and will not be used to inform decisions for the site. Due to the changing regulatory environment for PFAS, decision screening levels will be determined at a later date. • If PFAS concentrations are less than the project screening levels (i.e., the laboratory LODs), then PFAS are not considered to be present for the purposes of the SI. • If PFAS concentrations are greater than the project screening levels, PFAS are present. The final waste characterization and disposal plan for investigation-derived waste (IDW) will be conducted in accordance with Army guidance and state/local regulations. Disposition of IDW is discussed in **Worksheet #17** of this QAPP Addendum.
Step 6: Specify Performance or Acceptance Criteria:
Controls on precision, reporting, and accuracy are provided in Worksheets #12 and #28 of the PQAPP. Field monitoring and detection equipment will be routinely calibrated, as detailed in Worksheet #22 of the PQAPP, to confirm that equipment used is of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results.
Step 7: Develop the Plan for Obtaining Data:
The detailed sampling plan and rationale for this SI is presented in **Worksheet #17** of this QAPP Addendum. Sampling plans may be revised based on field conditions or site planning meetings.

424

QAPP ADDENDUM WORKSHEET #13: SECONDARY DATA USES AND LIMITATIONS

(UFP-QAPP Manual Section 2.7)

(USEPA 2106-G-05 Chapter 3: QAPP Elements for Evaluating Existing Data)

This worksheet identifies sources of secondary data not generated for the specific purpose of this project, or data generated under a separate QAPP, and summarizes their uses for this project. A full list of references reviewed to complete the SI at PICA will be provided in the SI Report.

Data Type	Source	Data Uses Relative to Current Project	Factors Affecting the Reliability of Data and Limitations on Data Use
Aerial Imagery	ESRI, ArcGIS Online Aerial Imagery	Provided georeferenced aerial photos for figure backdrops.	Changes in land features may not be apparent on current or historical imagery.
Past Site Investigations	Final Remedial Investigation Report MMRP RI (Weston Solutions 2014) Site-Specific Final Report MMRP Construction Support (PIKA 2014) UFP-QAPP Remedial Investigation for MMRP (Arcadis/Malcolm Pirnie and Weston Solutions 2012) Time Critical Removal Action Report Mount Hope Quarry (Malcolm Pirnie 2007) Preliminary Assessment for PFAS (Arcadis 2019)	Provided regional site conditions, historical site usage, historical contaminant identification and concentrations, and remedial actions	Site usage histories may omit records of AFFF procurement and use. There are limited PFAS data available *from previous investigations.* With the exception of the data collected during the pre-SI investigation conducted as part of the 2019 PA, it cannot be verified that historical sample collection or laboratory analysis for PFAS constituents was conducted in an acceptable manner for usable data.
Installation Personnel Interviews	Various	Provided anecdotal histories of site use, AFFF use, and remedial actions completed.	Several installation personnel who would have worked on site during the peak of AFFF use are retired or out of contact.
NJDEP Well Records	NJDEP	Identify off-site wells	Database may not be complete; well locations are approximate.

QAPP ADDENDUM WORKSHEET #14 & #16: PROJECT TASKS & SCHEDULE

(UFP-QAPP Manual Section 2.8.2)
(USEPA 2106-G-05 Section 2.2.4)

The project schedule is presented below for sampling activities planned at PICA as part of the SI following completion of previous steps listed in Worksheet #14 & #16 of the PQAPP.

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Installation site visits	Arcadis	5/4/18	5/8/18	Field notes (included in PA Report)	Complete
Obtain off-site well information from NJDEP (NJDEP database and well logs)	Arcadis	11/1/18	5/30/19	Excel table listing well construction details, ownership, and distance from PICA	Complete
Identify off-site private wells for sampling	Arcadis	11/1/18	7/1/19	List of off-site wells to be sampled; including owner and lot/block	Complete
Ground truth on-site sample locations	Arcadis	2/5/19	2/7/19	Well inspection logs	Complete
Mobilization and set up for off-site sampling[1]	Arcadis	5/15/19	TBD	Field notes (included in SI report)	NA
Off-site sampling of private wells	Arcadis	5/15/19	TBD	Field notes and measurements (included in SI report)	Submitted in SI report
Sample Analysis of private wells	ELLE	5/16/19	TBD	Analytical data package and electronic data deliverable	Submitted in SI report
Data Validation of private wells	Arcadis	6/10/19	TBD	Data validation report	Submitted in SI report
Send results letter to off-site private well owners	Arcadis	7/1/19	TBD	Results letters	TBD
Draft Sampling Letter Report (if requested) of private wells	Arcadis	TBD	TBD	Sampling Letter Report (if requested)	(20 days after data validation)

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Draft Final QAPP Addendum and Site Safety and Health Plan (SSHP, included as **Attachment 3** provided under separate cover)	Arcadis	9/19/19	9/30/19	Draft QAPP Addendum	9/30/19
Army review of Draft QAPP Addendum	Army	10/15/19	10/16/19	Comments on Draft QAPP Addendum	10/18/19
Regulator review of Draft Final QAPP Addendum	USEPA/NJDEP	10/21/19	10/31/19	Comments on Draft Final QAPP Addendum	10/31/19
Final QAPP Addendum and SSHP	Arcadis	10/31/19	11/4/19	Final QAPP Addendum and SSHP	11/4/19
Mobilization and set up for on-site sampling	Arcadis and subcontractors	11/4/19	TBD	Field notes (included in SI report)	Not Applicable (NA)
Sample collection of surface water and sediment	Arcadis	11/4/19	TBD	Field notes and measurements (included in SI Report)	Submitted in SI Report
Sample collection of groundwater from existing monitoring wells	Arcadis	11/4/19	TBD	Field notes and measurements (included in SI Report)	Submitted in SI Report
Soil boring/temporary well advancement, sample collection of soil and groundwater, and boring abandonment	Arcadis and subcontractors	11/4/19	TBD	Field notes and measurements (included in SI Report)	Submitted in SI Report
Sample Analysis for on-site sampling	ELLE	TBD	TBD	Analytical data package and electronic data deliverable	Submitted in SI Report
Preliminary Data Review Teleconference (if requested)	Arcadis	TBD	TBD	Draft data figures and tables (if requested)	TBD
Data Validation for onsite sampling	Arcadis	TBD	TBD	Data validation report	Submitted in SI Report
Draft Sampling Letter Report (if requested) of onsite sampling	Arcadis	TBD	TBD	Sampling Letter Report (if requested)	(20 days after data validation)
Draft SI Report	Arcadis	TBD	TBD	Draft SI Report	(90 days after data validation)

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Final SI Report	Arcadis	TBD	TBD	Final SI Report	TBD

1 – Two properties potentially having a private well have not yet responded to an inquiry regarding whether or not a private well is present. If these owners do respond, and a private well is present, another sampling event for off-site private domestic wells could occur.

QAPP ADDENDUM WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLES

(UFP-QAPP Manual Section 2.6.2.3)
(USEPA 2106-G-05 Section 2.2.6)

This worksheet provides the laboratory-specific limits for the PFAS compounds that will be analyzed, including the typical limit of quantitation (LOQ) and LOD, as provided by the laboratory. The LOQ is "the smallest concentration that produces a quantitative result with known and recorded precision and bias," and the LOD is "the lowest concentration for reliable reporting of a non-detect of a specific analyte in a specific medium with a specific method at 99 percent confidence" (DoD 2017). For the purposes of this SI, the project screening levels are defined as the LOD. Because project screening levels are equivalent to the LODs, project screening levels will vary slightly depending on batch- or sample-specific LODs reported by the laboratory for each analyte. If PFAS are detected greater than the project screening levels, PFAS are present. Concentrations detected between the LOD and LOQ are estimates, and therefore, will be qualified and indicated as such on laboratory analytical reports.

Media: Groundwater/Surface water		Analytical Group: PFASs (ELLE) per DoD Quality Systems Manual (QSM) 5.1.1 (or later version) Table B-15		
Analyte	**CAS Number**	**Project Screening Level (ng/L)**	**Laboratory-Specific Limits**	
			LOQ (ng/L)	**LOD (ng/L)**
Perfluorobutanoic acid (PFBA)	375-22-4	6	6	6
Perfluoropentanoic acid (PFPA)	2706-90-3	6	6	6
Perfluorohexanoic acid (PFHxA)	307-24-4	3	3	3
Perfluoroheptanoic acid (PFHpA)	375-85-9	1	1	1
Perfluorooctanoic acid (PFOA)	335-67-1	1	1	1
Perfluorononanoic acid (PFNA)	375-95-1	2	2	2
Perfluorodecanoic acid (PFDA)	335-76-2	3	3	3
Perfluoroundecanoic acid (PFUnA)	2058-94-8	2	2	2

Media: Groundwater/Surface water		Analytical Group: PFASs (ELLE) per DoD Quality Systems Manual (QSM) 5.1.1 (or later version) Table B-15		
Analyte	**CAS Number**	**Project Screening Level (ng/L)**	**Laboratory-Specific Limits**	
			LOQ (ng/L)	**LOD (ng/L)**
Perfluorododecanoic acid (PFDoA)	307-55-1	1	1	1
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	2	2	2
Perfluorotetradecanoic acid (PFTA)	376-06-7	2	2	2
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1	1	1
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	2	2	2
Perfluorooctane sulfonate (PFOS)	1763-23-1	2	2	2
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	2991-50-6	3	3	3
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	2355-31-9	3	3	3
6:2 Fluorotelomer sulfonate	27619-97-2	9	9	9
8:2 Fluorotelomer sulfonate	39108-34-4	6	6	6

Note:
CAS - Chemical Abstracts Service
ng/L – nanogram per liter

459

Media: Soil		Analytical Group: PFASs (ELLE) per DoD QSM 5.1.1 (or later version) Table B-15		
Analyte	**CAS Number**	**Project Screening Level (ng/g)**	**Laboratory-Specific Limits**	
			LOQ (ng/g)	**LOD (ng/g)**
Perfluorobutanoic acid (PFBA)	375-22-4	0.6	0.6	0.6
Perfluoropentanoic acid (PFPA)	2706-90-3	0.6	0.6	0.6
Perfluorohexanoic acid (PFHxA)	307-24-4	0.6	0.6	0.6
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.6	0.6	0.6
Perfluorooctanoic acid (PFOA)	335-67-1	0.6	0.6	0.6
Perfluorononanoic acid (PFNA)	375-95-1	0.6	0.6	0.6
Perfluorodecanoic acid (PFDA)	335-76-2	1	1	1
Perfluoroundecanoic acid (PFUnA)	2058-94-8	0.6	0.6	0.6
Perfluorododecanoic acid (PFDoA)	307-55-1	0.6	0.6	0.6
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.6	0.6	0.6
Perfluorotetradecanoic acid (PFTA)	376-06-7	0.6	0.6	0.6
Perfluorobutanesulfonic acid (PFBS)	375-73-5	0.6	0.6	0.6
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.6	0.6	0.6
Perfluorooctane sulfonate (PFOS)	1763-23-1	0.6	0.6	0.6
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	2991-50-6	2	2	2
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	2355-31-9	2	2	2

Media: Soil		Analytical Group: PFASs (ELLE) per DoD QSM 5.1.1 (or later version) Table B-15		
Analyte	CAS Number	Project Screening Level (ng/g)	Laboratory-Specific Limits	
			LOQ (ng/g)	LOD (ng/g)
6:2 Fluorotelomer sulfonate	27619-97-2	2	2	2
8:2 Fluorotelomer sulfonate	39108-34-4	2	2	2

Notes:
ng/g – nanogram per gram

Medium: Potable Water		Analytical Group: PFASs (ELLE) per DoD QSM 5.1.1 (or later version) EPA 537		
Analyte	CAS Number	Project Screening Level (ng/L)	Laboratory-Specific Limits	
			LOQ (ng/L)	LOD (ng/L)
Perfluorohexanoic acid (PFHxA)	307-24-4	1.5	2	1.5
Perfluoroheptanoic acid (PFHpA)	375-85-9	1.5	2	1.5
Perfluorooctanoic acid (PFOA)	335-67-1	1.5	2	1.5
Perfluorononanoic acid (PFNA)	375-95-1	1.5	2	1.5
Perfluorodecanoic acid (PFDA)	335-76-2	1.5	2	1.5
Perfluoroundecanoic acid (PFUnA)	2058-94-8	1.5	2	1.5
Perfluorododecanoic acid (PFDoA)	307-55-1	1.5	2	1.5
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	1.5	2	1.5
Perfluorotetradecanoic acid (PFTA)	376-06-7	1.5	2	1.5

Medium: Potable Water		Analytical Group: PFASs (ELLE) per DoD QSM 5.1.1 (or later version) EPA 537		
Analyte	CAS Number	Project Screening Level (ng/L)	Laboratory-Specific Limits	
			LOQ (ng/L)	LOD (ng/L)
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1.3	2	1.3
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	1.4	2	1.4
Perfluorooctane sulfonate (PFOS)	1763-23-1	1.4	2	1.4
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	2991-50-6	1.5	2	1.5
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	2355-31-9	1.5	2	1.5

465

QAPP ADDENDUM WORKSHEET #17: SAMPLING DESIGN AND RATIONALE

UFP-QAPP, PFAS Sampling Activities

(UFP-QAPP Manual Section 3.1.1)
(USEPA 2106-G-05 Section 2.3.1)

The DQOs for the sampling are described in **Worksheet #11** of this QAPP Addendum. This worksheet provides the detailed rationale and approach for site-specific sampling at PICA. This QAPP Addendum has been developed to ensure the amount, type, and quality of data are sufficient to determine which areas and environmental media are impacted with detectable levels of PFAS.

Environmental data will be collected as presented within this QAPP Addendum and in accordance with the field SOPs provided in Appendix A to the PQAPP at the locations defined in **Worksheet #18** and on **Figures 20 to 33** of this QAPP Addendum, along with the QC sample requirements listed in **Worksheet #20** of this QAPP Addendum. Note that **Figures 20-22** show the Former Pyrotechnic Area, Former Building 24 and Building 169 – Firehouse 1; however, no samples are required from these AOPIs since concentrations above the HAL were detected in groundwater collected from this AOPI during the pre-SI sampling event. Therefore, these AOPIs will be further addressed in the RI. **Attachment 4** also contains an SOP specific to the collection of groundwater samples from off-site private wells. Components of some SOPs may require modification or be superseded by the PFAS TGI (P-10 in Appendix A to the PQAPP) and/or PFAS Sampling and Analysis White Paper (Appendix B to the PQAPP) to accommodate PFAS-specific sampling requirements (Arcadis 2018b). The sampling methods described in the SOPs establish equipment requirements; procedures for equipment and containers before sampling; sampling procedures under various conditions; equipment blank samples and field duplicate collection requirements; and requirements for storing samples to ensure that sample contamination does not occur during collection, transport, and analysis. All field activities will be conducted in accordance with the approved Programmatic Accident Prevention Plan (Arcadis 2018a) and SSHP.

The areas of focus for this SI were selected based on a review of historical documents and data and information obtained by conducting personal interviews during the PA; these information inputs were used to develop the preliminary drinking water CSMs provided in **Worksheet #10** and on **Figures 8 through 17** of this QAPP Addendum.

Surface water, and groundwater will be sampled to identify PFAS presence, type (of the selected constituents as listed in **Worksheet #15** of this QAPP Addendum, including PFOS/PFOA), and concentrations. Soil will be sampled to identify PFAS presence, type (of the 18 selected constituents as listed in Worksheet #18 of the PQAPP, including PFOS/PFOA), and concentrations, as well as for total organic carbon (TOC), pH, and grain size (except where otherwise noted. These targeted sampling areas are believed to have the potential for the greatest PFAS concentrations closest to known releases of AFFF. PFAS has been detected in monitoring wells and drinking water wells near the southern boundary of the installation and in a private well located approximately 0.58 miles off-post during previous investigation activities.

Results of the sampling will be compiled and analyzed by Arcadis and presented in an SI Report. The report will summarize the field effort and present the validated sampling results, including QA/QC.

The planned project schedule to complete the SI for PICA is provided in **Worksheet #14 & 16** of this QAPP Addendum. The mobilization schedule will be determined upon the finalization of this QAPP Addendum. Prior to conducting any on-site sampling the locations will be field verified. Necessary permits, forms, or other project documentation, subcontracts, or project equipment will be procured before mobilization. Before conducting intrusive activities, the location of underground utilities will be determined. Utility companies and other responsible authorities will be contacted to locate and mark the locations. Installation-specific health and safety training will be completed by the field team prior to conducting any field work. In addition, an unexploded ordnance technician will clear the sampling areas. The investigation team will demobilize once field activities are complete. IDW (including soil cuttings, and water from decontamination of drill tooling), which may potentially contain PFAS, will be disposed of in accordance with NJDEP requirements, which allow the water and cuttings to be placed back where they came from. All non-IDW wastes will be removed from the site immediately upon completion of each day's field activities. A post-activity inspection will be conducted by the field team lead/regional lead and SSHO identified in the this QAPP Addendum and the attached SSHP (**Attachment 3**) to ensure the location is left clean.

Groundwater Sampling

Groundwater samples were previously collected from existing domestic wells. Refer to **Attachment 5** for a copy of the letters/questionnaires sent to the property owners. Groundwater samples will be collected from existing monitoring wells, existing domestic wells (if any additional wells are present downgradient of PICA), as well as temporary locations. At existing monitoring wells, the groundwater samples will be collected using low-flow sampling techniques; the type of pump used will depend on the depth of the well. The samples will be collected from approximately the center of the saturated screened interval. For existing domestic wells, the samples have been and, if required, will be collected in accordance with the SOP (**Attachment 4**). The temporary groundwater samples will be collected from screen point samplers targeting different depths. The exact depth of sample collection will be determined by the geologist/hydrogeologist using field observations during drilling and the equipment capabilities. Groundwater samples will be collected from 10 areas:

- Former Lower Burning Grounds
- Former WWTP Facility
- Post Farm Landfill
- Building 3316 – Firehouse 2
- Lawn N of Building 3409/3410 (temporary wells)
- NJARNG Helipad
- Area 1222 Gorge
- Eastern Boundary On-Site
- Northern Boundary On-Site (temporary wells)
- MidValley Upgradient onsite

Groundwater samples will be analyzed for select PFAS, and field parameters (temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential) will be measured during purging and allowed to stabilize (or purged for a maximum of 20 minutes, whichever is sooner) before groundwater sampling to ensure a representative sample is collected and, potentially, to inform the interpretation of analytical data. Groundwater samples will be collected to inform the interpretation of PFAS distribution and

548 migration and update the individual AOPI drinking water CSMs. Coordinates for each borehole's
549 groundwater sampling location will be recorded using a handheld global positioning system (GPS).

550 **Potable Water Source Sampling Off Site**

551 The following additional steps have been conducted for sampling the off-site wells.

552 • Well records were obtained from NJDEP (database and well logs).
553 • The wells were record-truthed (e.g., review well logs, tax records).
554 • Local health departments and water departments were contacted for additional information about
555 properties that potentially have potable wells.
556 • Property owners within 1 mile downgradient of the southern boundary of the installation were
557 contacted.
558 • Once domestic wells within the downgradient area were identified as being present, and the
559 owner agreed that the well could be sampled, samples were collected. Note that two owners have
560 not yet responded to a letter asking if they have a property well, nor where they home during
561 several door-to-door visits.
562 • Once the sampling data were obtained, the results were/will be reviewed to determine if an
563 emergency action was required and if additional step-out sampling is required. To date, one
564 private well owner was provided bottled water on an interim basis. NJDEP plans on connecting
565 this property to the public water system.
566 • Once the data were validated, results letters were sent to the property owners.

567 **Soil Sampling**

568 Soil samples will be collected to inform the interpretation of PFAS distribution, determine residual source
569 strength of potential PFAS release areas, evaluate the potential for those areas to be sources of PFAS to
570 surface water and groundwater as an influence to drinking water, and update the individual AOPI CSMs.
571 Soil samples will be analyzed for select PFAS, TOC, pH, and grain size; soil lithological descriptions will be
572 continuously logged and will be documented on field forms. At locations accessible by drill rig, soil samples
573 will be collected from the near surface (i.e., less than 6-inches below the top soil) and in the capillary zone
574 immediately above the water table. If the drill rig cannot access the sample location, only a near surface
575 sample will be collected. Soil samples will be collected from 6 areas:

576 • Former Lower Burning Grounds
577 • Former WWTP Facility
578 • Building 3316 – Firehouse 2
579 • Lawn N of Building 3409/3410 (temporary wells)
580 • NJARNG Helipad
581 • Area 1222 Gorge.

582 Direct push technology (DPT) boring and sampling will be completed using a dual-tube, top-down method.
583 Coordinates for each soil sampling location will be recorded using a handheld GPS.

584 **Surface Water Sampling**

585 Surface water samples will be collected to inform the presence or absence of PFAS in possible secondary
586 source areas. The surface water samples will be collected from on-site non-intermittent sources of surface
587 water. Grab surface water samples will be collected from 7 areas (5 AOPIs as well as other upstream and
588 downstream locations) (**Figure 33):**

589 • Former Lower Burning Grounds
590 • Former WWTP Facility

- Lawn N of Building 3409/3410
- NJARNG Helipad
- Area 1222 - Gorge
- Eastern Boundary On-Site
- Northern Boundary On-Site

Surface water samples will be collected from downstream to upstream to reduce siltation in sequential samples. All surface water samples will be analyzed for select PFAS, and field parameters (temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential) will be measured during surface water sampling to potentially inform the interpretation of analytical data. Coordinates for each surface water sampling location will be recorded using a handheld GPS.

Laboratories

ELLE will be used for this study. ELLE is a nationally accredited laboratory and has met the certification requirements of NJDEP. They hold laboratory certification identification number PA011, which expires June 30, 2020. PFAS analyses will be conducted in accordance with the DoD QSM 5.1.1 (or later version as the laboratory obtains updated certification), Table B-15 for the analytes listed in Worksheet #18 of the PQAPP. Arcadis will validate the data from the laboratory in accordance with Worksheets #34, #35, and #36 of the PQAPP. A Data Usability Summary Report will be prepared in accordance with the USACE Environmental Quality: Guidance for Evaluating Performance-Based Chemical Data, Engineer Manual 200-1-10 (USACE 2005) that will review precision, accuracy, completeness, representativeness, comparability, and sensitivity. This information will be included in an SI Report.

QAPP ADDENDUM WORKSHEET #18: SAMPLING LOCATIONS AND METHODS

(UFP-QAPP Manual Section 3.1.1 and 3.1.2)
(USEPA 2106-G-05 Section 2.3.1 and 2.3.2)

The tentative sampling locations, identifications, and associated analytes and parameters are summarized below; sampling locations well depths, and aquifer units are depicted on **Figures 24 through 33** for surface water, and soil. The group of PFAS constituents (including PFOS/PFOA) noted for analysis for groundwater, potable water, soil, and surface water samples in the table below is summarized for all media in **Worksheet #15** of this QAPP Addendum. **Worksheet #17** of this QAPP Addendum describes the rationale for the various sampling locations and media. Field activities and sampling procedures will be conducted in accordance with the TGI and SOP documents in Appendix A to the PQAPP (Arcadis 2018b). Additional information on PFAS sampling is available in the PFAS Sampling and Analysis White Paper (Appendix B to the PQAPP; Arcadis 2018b). The frequency requirements for QA/QC samples noted in Worksheet #20 of the PQAPP will be met. In addition to the requirements listed in Worksheet #20 of the PQAPP, a field reagent blank associated with potable water source sampling will be collected at a frequency of one per day as noted on **Worksheet #20** of this QAPP Addendum. **Worksheet #18** of this QAPP Addendum lists the number and type of QA/QC samples anticipated for each medium based on the sampling plan presented herein; however, the final number and identifications of QA/QC samples listed in the **Table 3** below are TBD based on progression of daily field activities. **Table 4** presents a summary of samples per media and location.

Table 3 – Sample Details

Site Location	Medium	Sample ID	Depth Interval (Approximate)	Sample Method	Sample Type	Number of Samples	Analytes
Former Pyrotechnic Area	Groundwater	PICA-PSL-1179-7	Mid-Saturated Screen	Grab	Normal	1	PFAS, field parameters[1]
		PICA-PSL-1179-4B					
		PICA-PSL-1179-3					
		PICA-PSL-TW-1					

Site Location	Medium	Sample ID	Depth Interval (Approximate)	Sample Method	Sample Type	Number of Samples	Analytes
Former Pyrotechnic Area	Surface Water	PICA-PSL-SW-1	Mid-Stream Depth	Grab	Normal, FD, MS/MSD	4	
		PICA-PSL-SW-2		Grab	Normal	1	
	Soil	PICA-PSL-SO-01-0-0.5	0-0.5 feet	DPT	Normal	1	PFAS, TOC, grain size, pH
		PICA-PSL-SO-01-DEPTH[2]	Above water table		Normal	1	
Former WWTP Facility	Groundwater	PICA-WWTP-80-1	Mid-Saturated Screen	Grab	Normal	1	PFAS, field parameters[1]
		PICA-WWTP-80-2					
		PICA-WWTP-80-3					
		PICA-WWTP-MW-12E					
	Surface Water	PICA-WWTP-SW-3	Mid-Stream Depth	Grab	Normal	1	
		PICA-WWTP-SW-4		Grab	Normal	1	
	Soil	PICA-WWTP-SO-02-0-0.5	0-0.5 feet	DPT	Normal	1	PFAS, TOC, grain size, pH

Site Location	Medium	Sample ID	Depth Interval (Approximate)	Sample Method	Sample Type	Number of Samples	Analytes
		PICA-WWTP-SO-02-DEPTH[2]	Above water table		Normal	1	
Post Farm Landfill	Groundwater	PICA-PFL-MW-1	Mid-Saturated Screen	Grab	Normal	1	PFAS, field parameters[1]
		PICA-PFL-MW-2					
		PICA-PFL-TW-2					
Southern Boundary On-Site	Groundwater	PICA-SAB-SB1-6	Mid-Saturated Screen	Grab	Normal	1	PFAS, field parameters[1]
		PICA-SAB-SB1-7					
Building 3316 – Firehouse 2	Groundwater	PICA-FH2-3316-1	Mid-Saturated Screen	Grab	Normal	1	PFAS, field parameters[1]
		PICA-FH2-3316-3					
		PICA-FH2--TW-3					
	Soil	PICA-FH2--SO-03-0-0.5	0-0.5 feet	DPT	Normal	1	PFAS, TOC, grain size, pH
		PICA-FH2--SO-03-DEPTH[2]	Above water table		Normal	1	

Site Location	Medium	Sample ID	Depth Interval (Approximate)	Sample Method	Sample Type	Number of Samples	Analytes
Lawn N of Building 3409/3410	Groundwater	PICA-LAW-TW-4	Mid-Saturated Screen	Grab	Normal	1	PFAS, field parameters[1]
		PICA-LAW-TW-5					
	Surface Water	PICA-LAW-SW-5	Mid-Stream Depth	Grab	Normal	1	
	Soil	PICA-LAW-SO-04-0-0.5	0-0.5 feet	DPT	Normal	1	PFAS, TOC, grain size, pH
		PICA-LAW-SO-04-DEPTH[2]	Above water table		Normal	1	
NJARNG Helipad	Groundwater	PICA-HEL-175MW-1	Mid-Saturated Screen	Grab	Normal	1	PFAS, field parameters[1]
		PICA-HEL-175MW-2					
	Surface Water	PICA-HEL-SW-6	Mid-Stream Depth	Grab	Normal	1	
	Soil	PICA-HEL-SO-05-0-0.5	0-0.5 feet	DPT	Normal	1	PFAS, TOC, grain size, pH
		PICA-HEL-SO-05-DEPTH[2]	Above water table		Normal	1	

Site Location	Medium	Sample ID	Depth Interval (Approximate)	Sample Method	Sample Type	Number of Samples	Analytes
Area 1222 Gorge	Groundwater	PICA-GRG-OD-4A	Mid-Saturated Screen	Grab	Normal	1	PFAS, field parameters[1]
		PICA-GRG-OD-5A					
		PICA-GRG-OD-6A					
		PICA-GRG-TW-6					
	Surface Water	PICA-GRG-SW-7	Mid-Stream Depth	Grab	Normal	1	
		PICA-GRG-SW-8		Grab	Normal	1	
	Soil	PICA-GRG-SO-06-0-0.5	0-0.5 feet	DPT	Normal	1	PFAS, TOC, grain size, pH
		PICA-GRG-SO-06-DEPTH[2]	Above water table		Normal	1	

Site Location	Medium	Sample ID	Depth Interval (Approximate)	Sample Method	Sample Type	Number of Samples	Analytes
Eastern Boundary On-Site	Groundwater	PICA-EAB-MW-26S	Mid-Saturated Screen	Grab	Normal	1	PFAS, field parameters[1]
		PICA-EAB-MW-27S					
		PICA-EAB-MW-28S					
		PICA-EAB-MW-29S					
		PICA-EAB-TW-6	Mid-Saturated Screen	Grab	Normal	1	
	Surface Water	PICA-EAB-SW-9	Mid-Stream Depth	Grab	Normal	1	
		PICA-EAB-SW-10		Grab	Normal	1	
Northern Boundary On-Site	Groundwater	PICA-NAB-TW-7	Mid-Saturated Screen	Grab	Normal	1	PFAS, field parameters[1]
		PICA-NAB-TW-8					
	Surface Water	PICA-NAB-SW-11	Mid-Stream Depth	Grab	Normal	1	
MidValley Upgradient On-Site	Groundwater	PICA-MVU-171MW-12	Mid-Saturated Screen	Grab	Normal	1	PFAS, field parameters[1]

Site Location	Medium	Sample ID	Depth Interval (Approximate)	Sample Method	Sample Type	Number of Samples	Analytes
Field Blank (1 per day)	Aqueous	PICA-FB-AQ-MMDDYY-1	NA	NA	FB	10	PFAS
Equipment Blank - Aqueous (1 per decon event or lot for disposable equipment)	EB	PICA-EB-AQ-MMDDYY-1	NA	NA	EB	TBD	
Field Duplicate - Aqueous (1 per 20 samples)	Aqueous	PICA-FD-AQ-MMDDYY-1	Duplicate	Grab	FD	2	
Equipment Blank - Soil (1 per decon event or lot for disposable equipment)	EB	PICA-EB-SO-MMDDYY-1	NA	NA	EB	TBD	PFAS, TOC
Field Duplicate - Soil (1 per 20 samples)	Soil	PICA-FD-SO-MMDDYY-1	Duplicate	Grab	FD	1	
MS/MSD - Soil/Aqueous (1 per 20 samples)	Soil/Aqueous	Same as parent sample	3x Volume	Grab	MS/MSD	3	

Notes:

1 – Field parameters include temperature, pH, conductivity, dissolved oxygen, turbidity, oxidation-reduction potential.
2 – Depth to be field determined and will be denoted as ## (below ground surface) in the sample name.
3 – Equipment Blank collected at a frequency of 1 per decon event or lot for disposable equipment. It is estimated 10 equipment blanks will be collected and locations will be determined by field staff.
4 – Field duplicates collected at a frequency of 1/20 samples. It is estimated 3 duplicates will be collected and locations will be determined by the field staff.
5 – Matrix spike and matrix spike duplicate (MS/MSD) samples to be collected at a frequency of 1/20 samples. It is estimated that 3 MS/MSD samples will be collected, and locations determined by the field staff.

Acronyms:
AQ – aqueous
DPT – direct push technology
EB – equipment blank

641 FB – field blank
642 FD – field duplicate
643 FH1 – Building 169 – Firehouse 1
644 ft bgs – feet below ground surface
645 LBG – Former Lower Burning Grounds
646 MS – matrix spike
647 MSD – matrix spike duplicate
648 MW – monitoring well
649 N – normal (parent)
650 PICA – Picatinny Arsenal
651 PSL – Pyrotechnic Area
652 SAB – Southern Area Boundary
653 SO - soil
654 SW – surface water
655 TW – temporary well
656 TBD – To Be DeterminedWWTP – Wastewater Treatment Plant
657

658

Table 4 – Media by AOPI Details

AOPI	Existing Wells	Temporary Wells	SW Samples	Soil Samples
Former Lower Burning Grounds	1179-7	TW-1	SW-1	SO-1 (0-6)
	1179-4B		SW-2	SO-1 (capillary)
	1179-3			
Former WWTP	80-1	TW-2	SW-3	SO-2 (0-6)
	80-2		SW-4	SO-2 (capillary)
	80-3			
	MW-12E			
Post Farm Landfill	23MW-1	NS	NS	NS
	23MW-2			
Building 3316 - Firehouse 2	3316-1	TW-3	N/A	SO-3 (0-6)
	3316-3			SO-3 (capillary)
Lawn N of Building 3409/3410	NS	TW-4	SW-5	SO-4 (0-6)
		TW-5		SO-4 (capillary)
NJARNG Helipad	175MW-1	NS	SW-6	SO-5 (0-6)
	175MW-2			SO-5 (capillary)
Area 1222 - Gorge	OD-4A	TW-6	SW-7	SO-6 (0-6)
	OD-5A		SW-8	SO-6 (capillary)
	OD-6A			
Eastern Boundary On-Site	MW-26S	NS	SW-9	NS
	MW-27S			
	MW-28S		SW-10	
	MW-29S			
Northern Boundary On-Site	NS	TW-7	SW-11	NS
		TW-8		
Mid-Valley Upgradient On-Site	171MW-12	NS	NS	NS
Count	**21**	**8**	**11**	**12**

Acronyms:
TW – temporary well
SW – surface water
MW – monitoring well
NS – no sample

QAPP ADDENDUM WORKSHEET #20: FIELD QC SUMMARY

(UFP-QAPP Section 3.1.1 and 3.1.2)
(USEPA 2106-G-05 Section 2.3.5)

Primary and QA/QC samples will be collected during field activities as noted below at the frequencies prescribed in Worksheet #20 of the PQAPP (Arcadis 2018b). Field blanks will be collected at a frequency of 1 per 20 primary samples (not medium-specific, except potable water sources for which field reagent blanks will be collected at a frequency of one per day). Source blanks will be collected from each source of water used for the initial decontamination step. Equipment blanks, field blanks, and source blanks will be analyzed for PFAS only (same analyte list for groundwater/surface water and soil/sediment on **Worksheet #15**). The field reagent blank associated with drinking water sampling will be analyzed for PFAS only (same analyte list as provided for drinking water on **Worksheet #15**).

Matrix	Analyte/Analytical Group	Normal Samples	FD	MS	MSD	EB	Total # analyses
Groundwater	PFAS	29	2	2	2	1 per piece of relevant equipment per sampling event	TBD
Surface Water	PFAS	11	1	1	1	1 per piece of relevant equipment per sampling event	TBD
Potable Water	PFAS	10	0	0	0	0	10
Soil	PFAS	12	1	1	1	1 per piece of relevant equipment per sampling event	TBD
	TOC	12	1	1	1	N/A	15
	pH	12	N/A	N/A	N/A	N/A	12

Matrix	Analyte/Analytical Group	Normal Samples	FD	MS	MSD	EB	Total # analyses
	Grain size	12	N/A	N/A	N/A	N/A	12

Notes:

1. Estimated 10 days of sampling; however, the exact number of equipment blanks and field blanks will be determined by progress.
2. The potable water samples have already been collected.

REFERENCES

Arcadis. 2018a. Accident Prevention Plan, A-E Services, PFAS contamination in the Cleanup/Restoration Programs at Active Army Installations – Nationwide. June.

Arcadis. 2018b. Final Programmatic Uniform Federal Policy Quality Assurance Project Plan, USAEC PFAS SI, Active Army Installations, Nationwide, USA. October.

Arcadis. 2019. Preliminary Assessment of Per- and Polyfluoroalkyl Substances, Picatinny Arsenal, NJ. February.

Arcadis/Malcolm Pirnie and Weston Solutions. 2012. Uniform Federal Policy-Quality Assurance Project Plan Remedial Investigation for Military Munitions Response Program Picatinny Arsenal, Rockaway Township, New Jersey. Contract No. W912DR-09-D-0006. February 2012.

Dames & Moore. 1991. Remedial Investigation Concept Plan for PICA Vol. 1 Environmental Setting, Applicable Regulations, Summaries of Site Sampling Plans, Sampling Priorities, and Supporting Append ices – USACE Toxic and Hazardous Materials Agency. March 1991.

DoD. 2009. Emerging Contaminants Instruction, Directive 4715.18. June.

DoD. 2012. Defense Environmental Restoration Program Management Manual 4715.20. March.

DoD. 2013. Defense Environmental Restoration Program Instruction 4715.07. May.

DoD. 2017. Fact Sheet: Detection and Quantitation – What Project Managers and Data Users Need to Know. Data Quality Working Group. October.

DoD. 2018. Quality Systems Manual, Version 5.1.1, 2018. February.

Lucey, Carol S. 1972. *Geology of Morris County in Brief. Bureau of Geology and Topography, Trenton, New Jersey*. 1972.

Malcolm Pirnie. 2007. *Site Specific Final Report Time Critical Removal Action Report Mount Hope Quarry Morris County, New Jersey*. October 2007.

PIKA (PIKA International, Inc.). 2014. *Final Site Specific Final Report MMRP Construction Support. Picatinny Arsenal, New Jersey. Prepared for the US Army Corps of Engineers*. February 2014.

USACE. 2005. Environmental Quality: Guidance for Evaluating Performance-Based Chemical Data, Engineer Manual 200-1-10, CEMP-RA/CECW-E, June 30.

USEPA. 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process. USEPA QA/G-4, EPA/240/B-06/001. February.

USEPA. 2016. Lifetime Health Advisories and Health Effects Support Documents for Perfluorooctanoic Acid and Perfluorooctane Sulfonate. EPA-HQ-OW-2014-0138; FRL-9946-91-OW. Federal Register/ Vol. 81. No. 101. May 25.

Weather Underground, Inc. 2013. Data download from 1 January 2003 to 1 January 2013 from weather station: Marcella/Wild Cat Ridge/Hawkwatch/Rockaway Township, Station ID: KNJMARCE1, accessed online (26 March 2013): http://www.wunderground.com/weatherstation/WXDailyHistory.asp?ID=KNJMARCE1&graphspan=custom&month=1&day=1&year=2003&monthend=1&dayend=1&yearend=2013

Weston Solutions. 2014. *Final Remedial Investigation Report Military Munitions Response Program Remedial Investigation Picatinny Arsenal. Morris County, New Jersey*. September 2014.

Figures

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

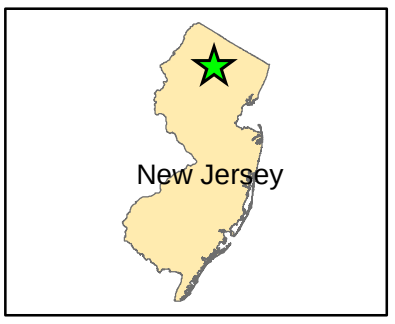
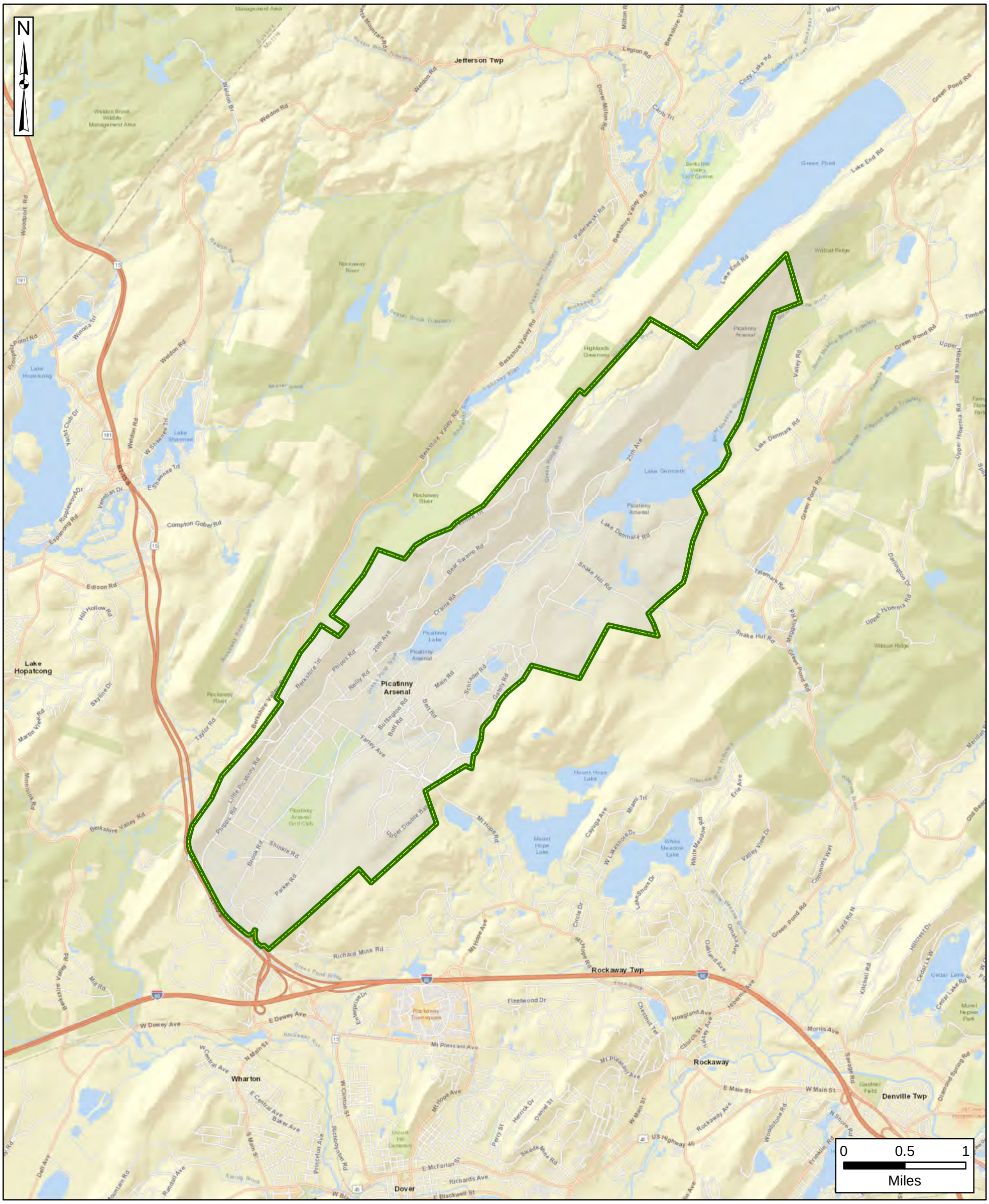


Figure 1
Picatinny Arsenal Location



Installation Boundary

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 2
Site Layout with Generalized Groundwater and Surface Water Flow Directions

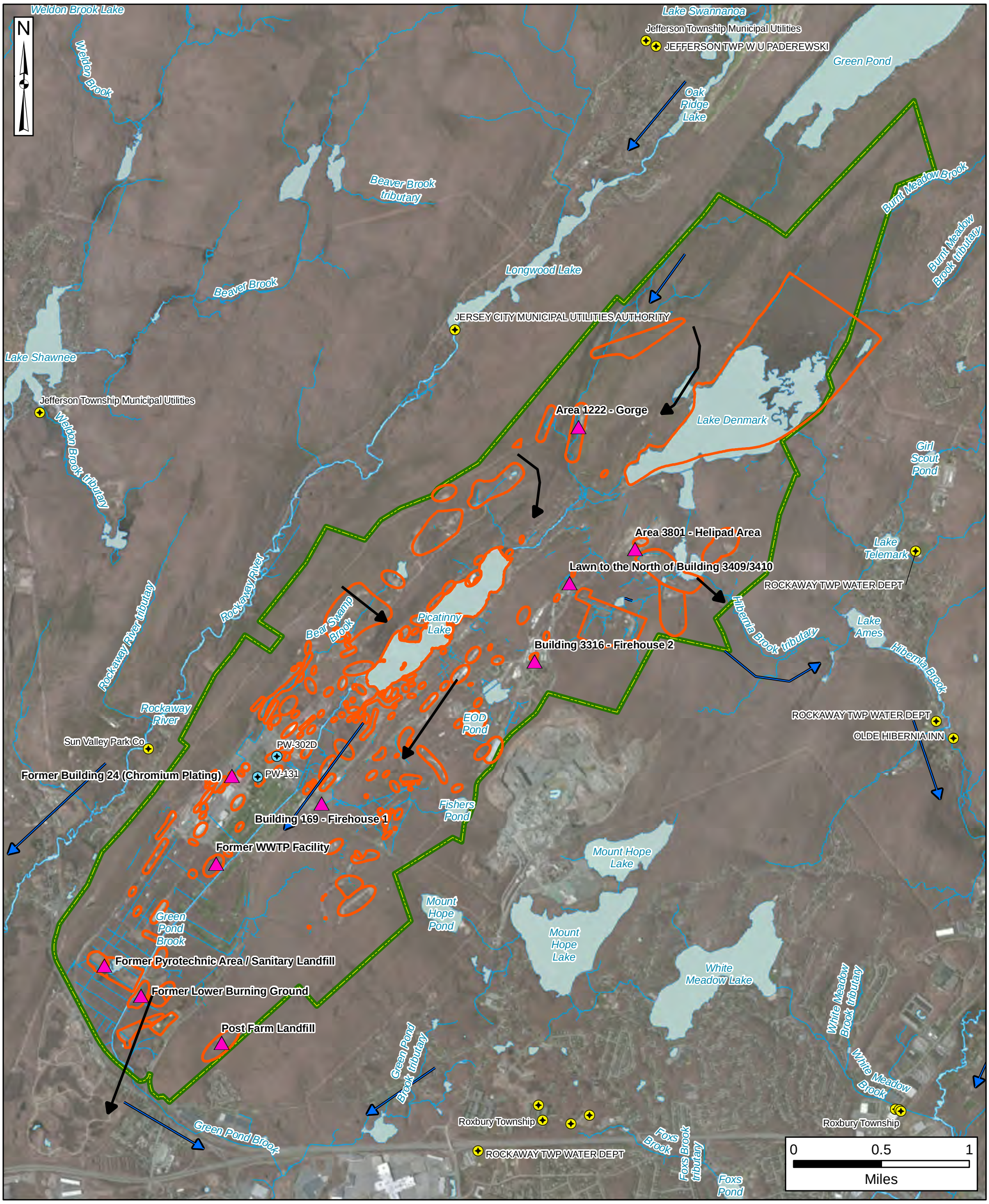
Installation Boundary
River/Stream
Water Body
Groundwater Flow Direction
Surface Water Flow Direction
Water Supply Well (On-Installation)
Water Supply Well (Off-Installation)

Data Sources:
Picatinny Arsenal, GIS Data, 2018
CEA, Well Data, 2018
EDR, Well Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 3
AOPI Locations



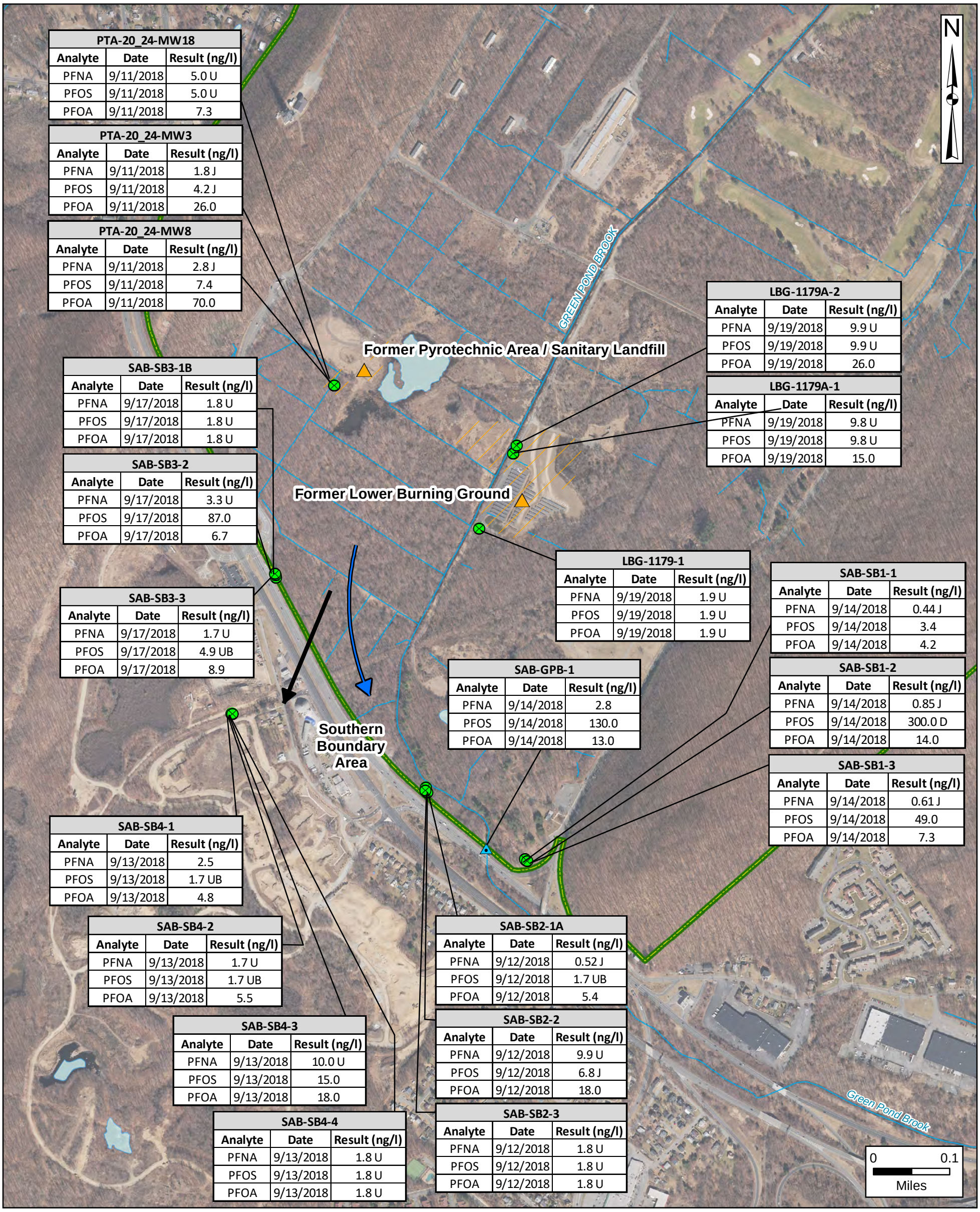
- Installation Boundary
- River/Stream
- Water Body
- Groundwater Flow Direction
- Surface Water Flow Direction
- AOPI Location
- Water Supply Well (On-Installation)
- Water Supply Well (Off-Installation)
- Installation Restoartion Program Site Area (Shaw, 2008)

Data Sources:
Picatinny Arsenal, GIS Data, 2018
EDR, Well Data, 2018
CEA, Well Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 4
Pre-SI Sampling Former Pyrotechnic Area and Sanitary Landfill, Former Burning Grounds, and Southern Boundary



PTA-20_24-MW18		
Analyte	Date	Result (ng/l)
PFNA	9/11/2018	5.0 U
PFOS	9/11/2018	5.0 U
PFOA	9/11/2018	7.3

PTA-20_24-MW3		
Analyte	Date	Result (ng/l)
PFNA	9/11/2018	1.8 J
PFOS	9/11/2018	4.2 J
PFOA	9/11/2018	26.0

PTA-20_24-MW8		
Analyte	Date	Result (ng/l)
PFNA	9/11/2018	2.8 J
PFOS	9/11/2018	7.4
PFOA	9/11/2018	70.0

LBG-1179A-2		
Analyte	Date	Result (ng/l)
PFNA	9/19/2018	9.9 U
PFOS	9/19/2018	9.9 U
PFOA	9/19/2018	26.0

LBG-1179A-1		
Analyte	Date	Result (ng/l)
PFNA	9/19/2018	9.8 U
PFOS	9/19/2018	9.8 U
PFOA	9/19/2018	15.0

SAB-SB3-1B		
Analyte	Date	Result (ng/l)
PFNA	9/17/2018	1.8 U
PFOS	9/17/2018	1.8 U
PFOA	9/17/2018	1.8 U

SAB-SB3-2		
Analyte	Date	Result (ng/l)
PFNA	9/17/2018	3.3 U
PFOS	9/17/2018	87.0
PFOA	9/17/2018	6.7

LBG-1179-1		
Analyte	Date	Result (ng/l)
PFNA	9/19/2018	1.9 U
PFOS	9/19/2018	1.9 U
PFOA	9/19/2018	1.9 U

SAB-SB1-1		
Analyte	Date	Result (ng/l)
PFNA	9/14/2018	0.44 J
PFOS	9/14/2018	3.4
PFOA	9/14/2018	4.2

SAB-SB3-3		
Analyte	Date	Result (ng/l)
PFNA	9/17/2018	1.7 U
PFOS	9/17/2018	4.9 UB
PFOA	9/17/2018	8.9

SAB-GPB-1		
Analyte	Date	Result (ng/l)
PFNA	9/14/2018	2.8
PFOS	9/14/2018	130.0
PFOA	9/14/2018	13.0

SAB-SB1-2		
Analyte	Date	Result (ng/l)
PFNA	9/14/2018	0.85 J
PFOS	9/14/2018	300.0 D
PFOA	9/14/2018	14.0

SAB-SB1-3		
Analyte	Date	Result (ng/l)
PFNA	9/14/2018	0.61 J
PFOS	9/14/2018	49.0
PFOA	9/14/2018	7.3

SAB-SB4-1		
Analyte	Date	Result (ng/l)
PFNA	9/13/2018	2.5
PFOS	9/13/2018	1.7 UB
PFOA	9/13/2018	4.8

SAB-SB4-2		
Analyte	Date	Result (ng/l)
PFNA	9/13/2018	1.7 U
PFOS	9/13/2018	1.7 UB
PFOA	9/13/2018	5.5

SAB-SB2-1A		
Analyte	Date	Result (ng/l)
PFNA	9/12/2018	0.52 J
PFOS	9/12/2018	1.7 UB
PFOA	9/12/2018	5.4

SAB-SB4-3		
Analyte	Date	Result (ng/l)
PFNA	9/13/2018	10.0 U
PFOS	9/13/2018	15.0
PFOA	9/13/2018	18.0

SAB-SB2-2		
Analyte	Date	Result (ng/l)
PFNA	9/12/2018	9.9 U
PFOS	9/12/2018	6.8 J
PFOA	9/12/2018	18.0

SAB-SB4-4		
Analyte	Date	Result (ng/l)
PFNA	9/13/2018	1.8 U
PFOS	9/13/2018	1.8 U
PFOA	9/13/2018	1.8 U

SAB-SB2-3		
Analyte	Date	Result (ng/l)
PFNA	9/12/2018	1.8 U
PFOS	9/12/2018	1.8 U
PFOA	9/12/2018	1.8 U

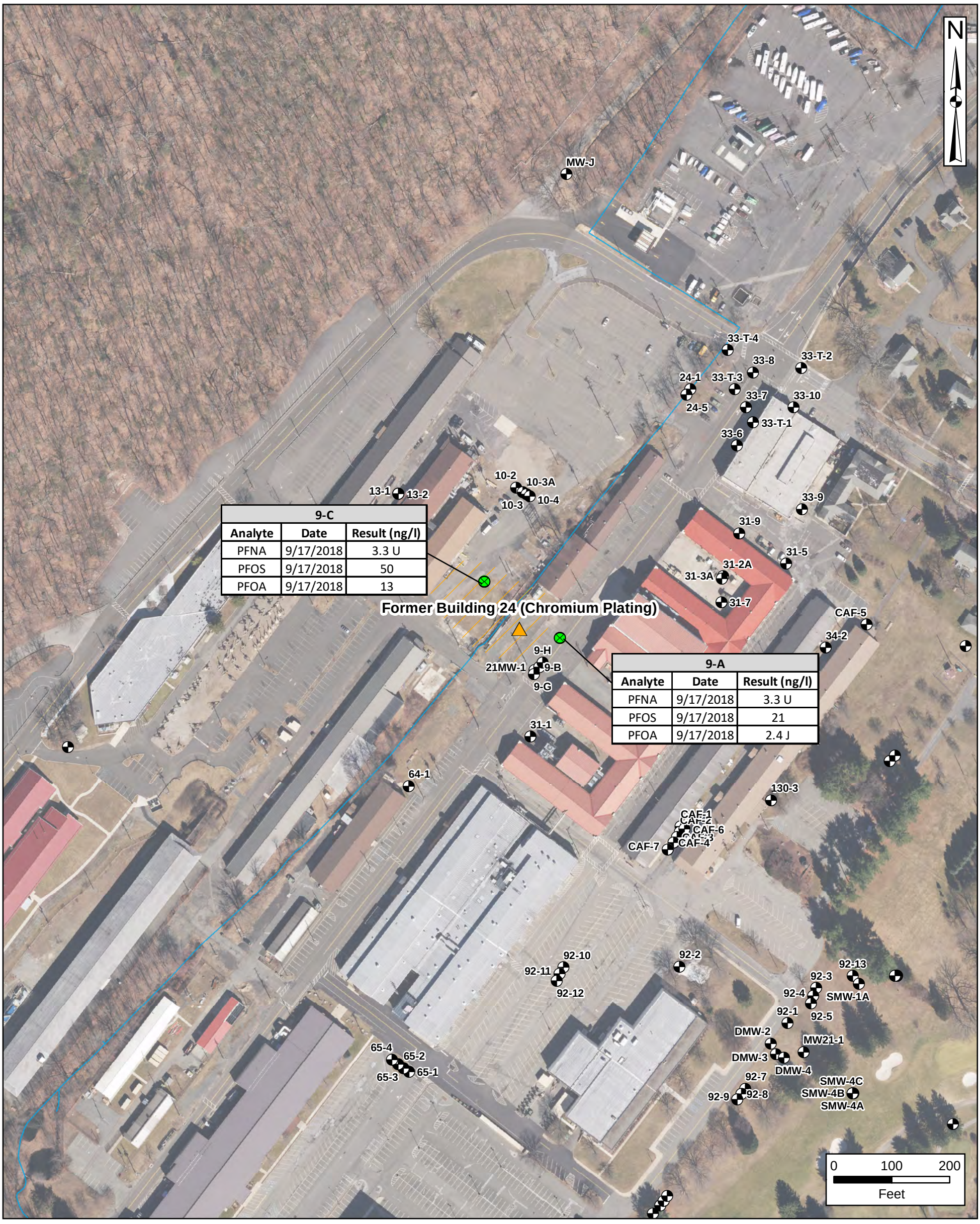
Installation Boundary
AOPI Location
AFFF Use Area
Surface Water Flow Direction
Assumed Groundwater Flow Direction
Groundwater Sampling Location
Surface Water Sampling Location

Note:
ng/l = nanograms per liter

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 5
Pre-SI Sampling Former Building 24



△ AOPI Location

◓ Monitoring Well

⊗ Groundwater Sampling Location

Note:
ng/l = nanograms per liter

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 6
Pre-SI Sampling Building 169
Firehouse 1

FH1-104-MW2		
Analyte	Date	Result (ng/l)
PFNA	9/11/2018	1.6 J
PFOS	9/11/2018	46.0
PFOA	9/11/2018	21.0

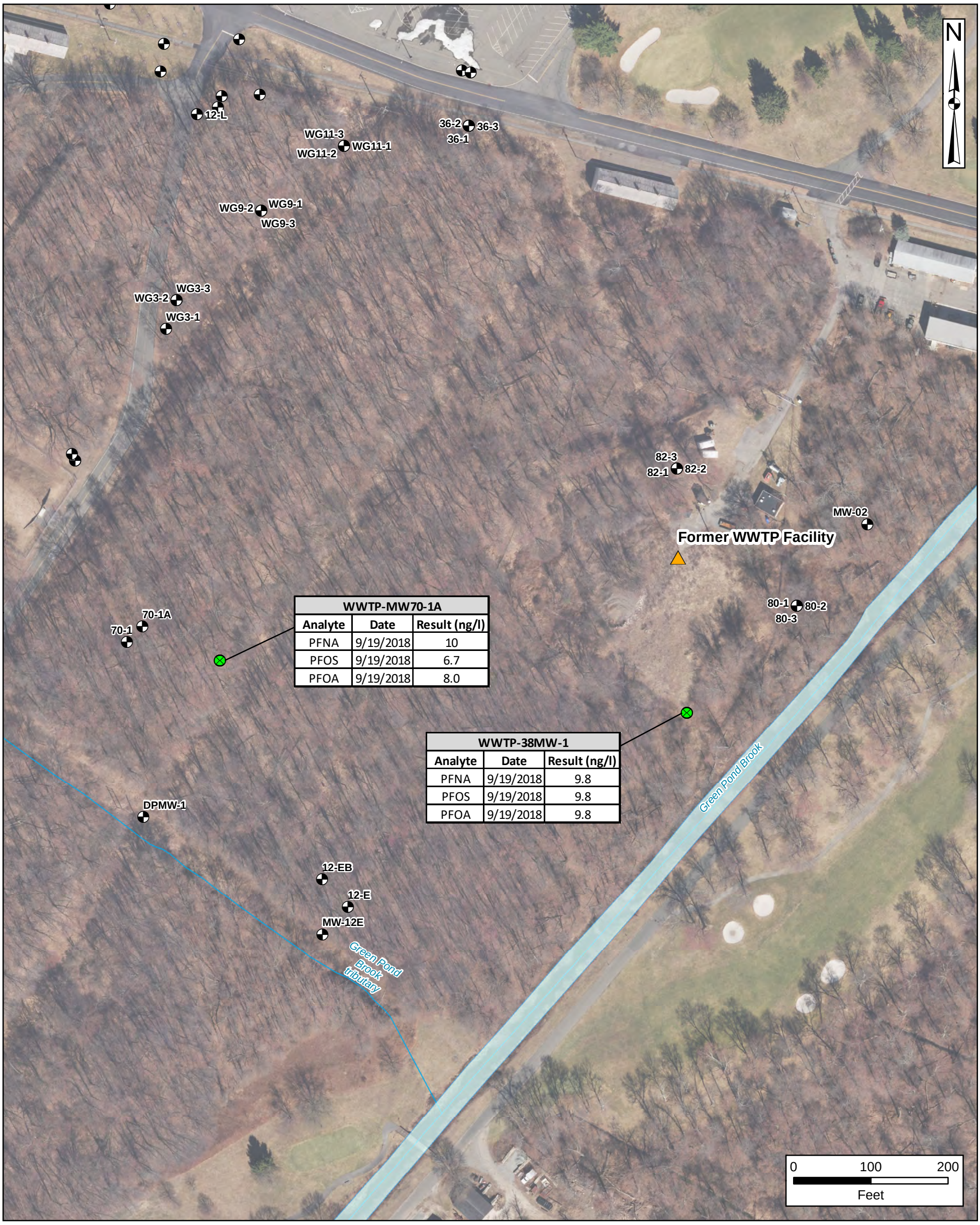
AOPI Location
AFFF Use Area
Monitoring Well
Groundwater Sampling Location

Note:
ng/l = nanograms per liter

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 7
Pre-SI Sampling Former WWTP



WWTP-MW70-1A		
Analyte	Date	Result (ng/l)
PFNA	9/19/2018	10
PFOS	9/19/2018	6.7
PFOA	9/19/2018	8.0

WWTP-38MW-1		
Analyte	Date	Result (ng/l)
PFNA	9/19/2018	9.8
PFOS	9/19/2018	9.8
PFOA	9/19/2018	9.8

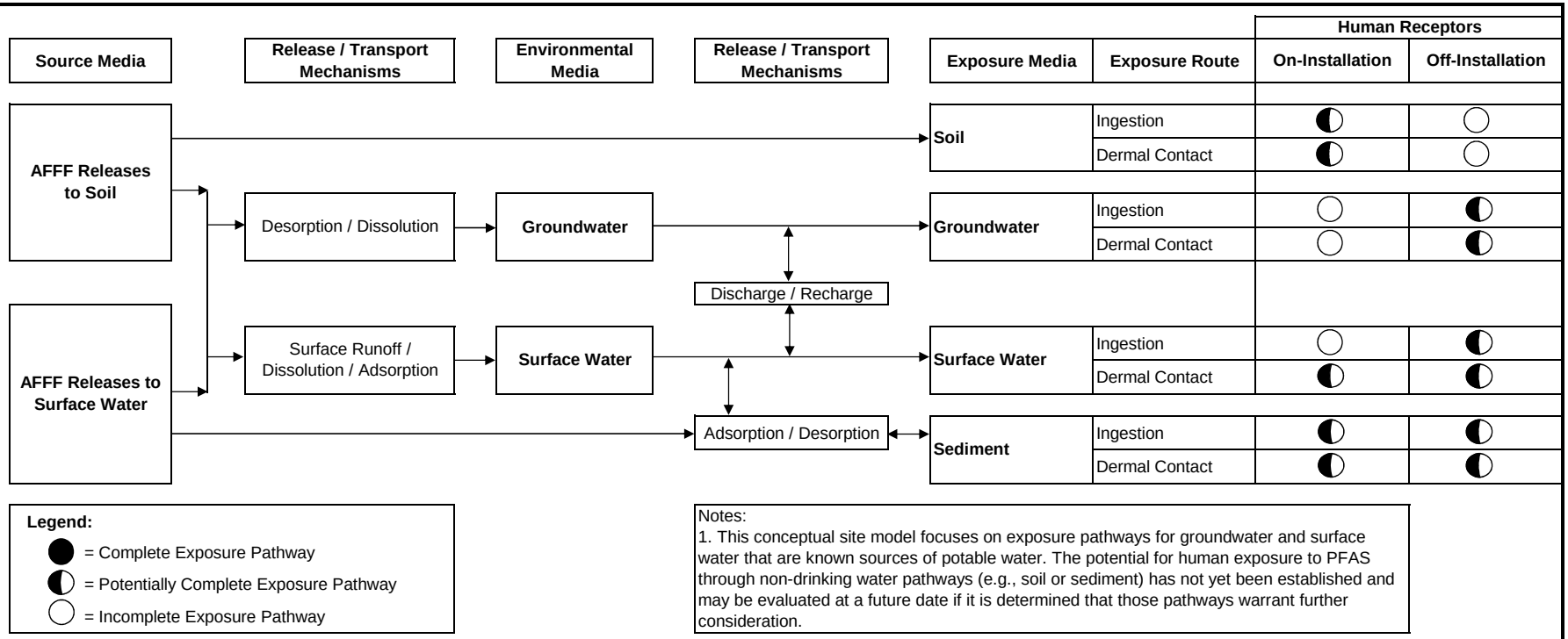
△ AOPI Location

Monitoring Well

Groundwater Sampling Location

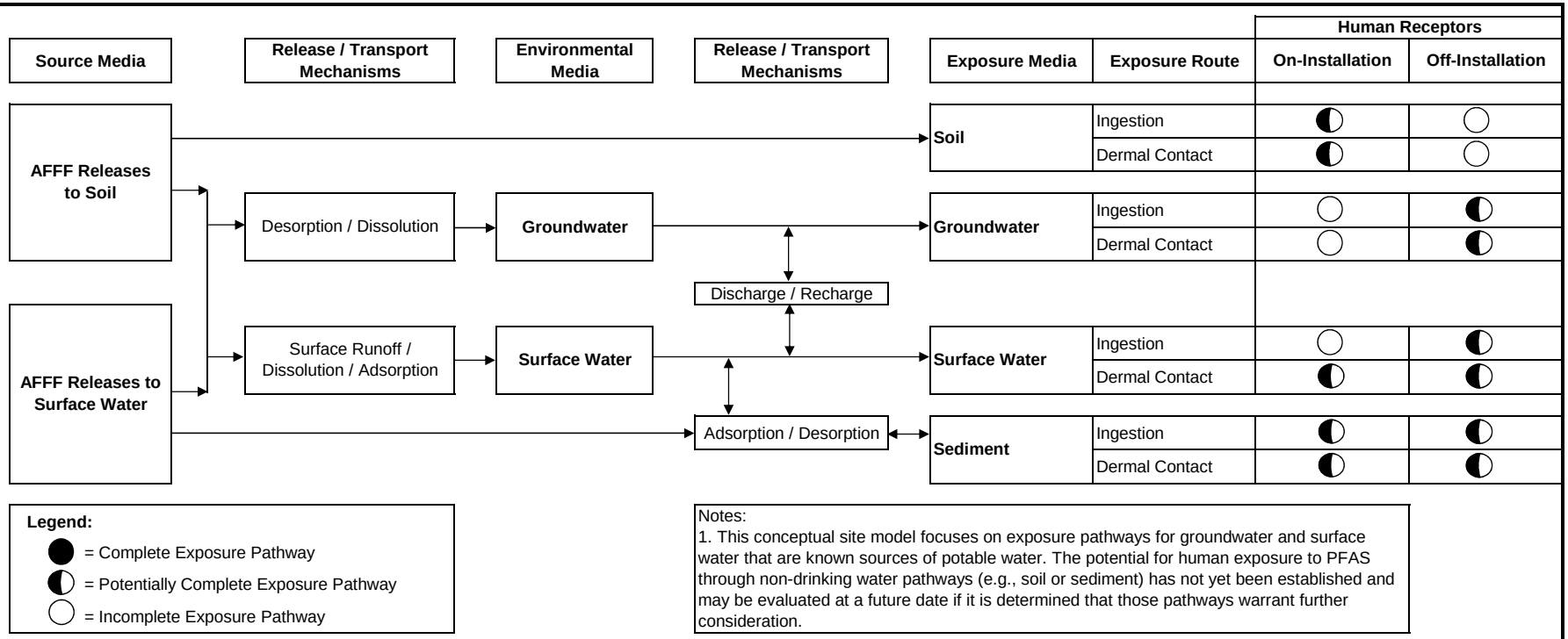
Note:
ng/l = nanograms per liter

Coordinate System:
WGS 1984, UTM Zone 18 North



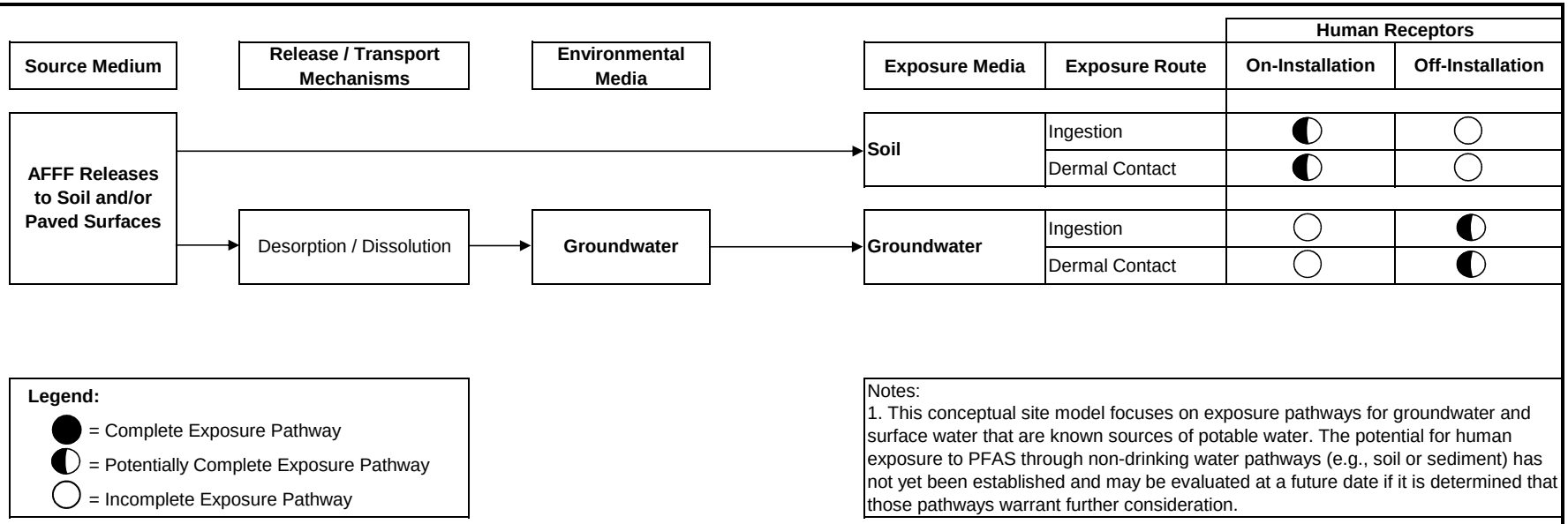
Conceptual Site Model for Drinking Water Pathway - AOPI Former Pyrotechnic Area and Sanitary Landfill
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 8



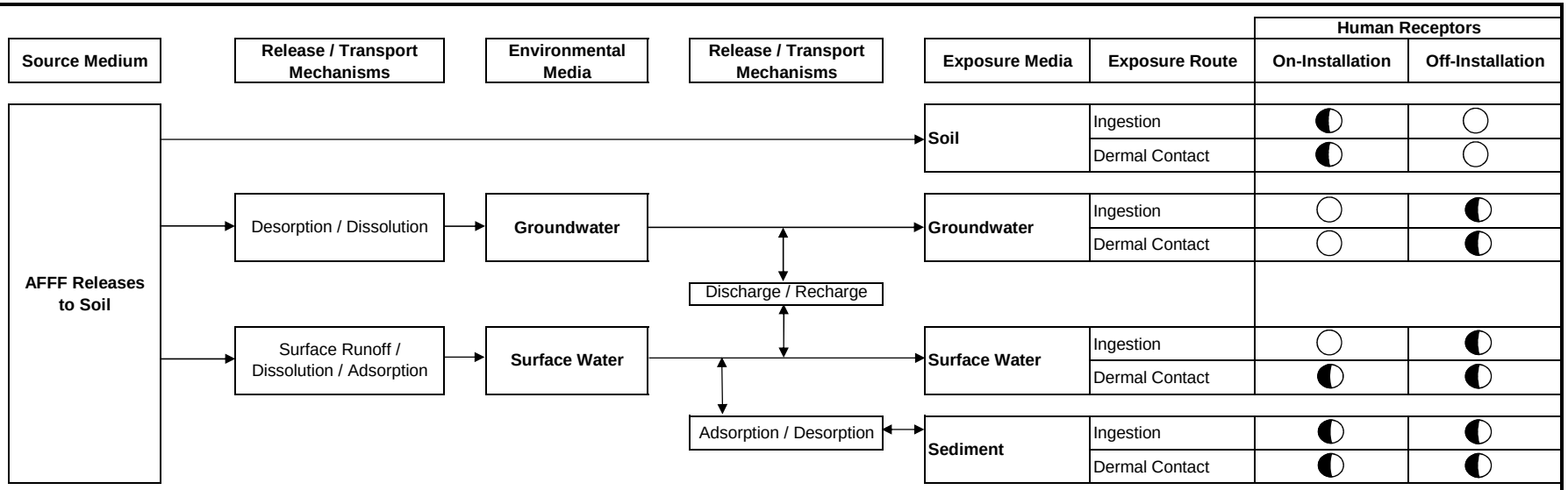
Conceptual Site Model for Drinking Water Pathway - AOPI Former Lower Burning Grounds
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 9



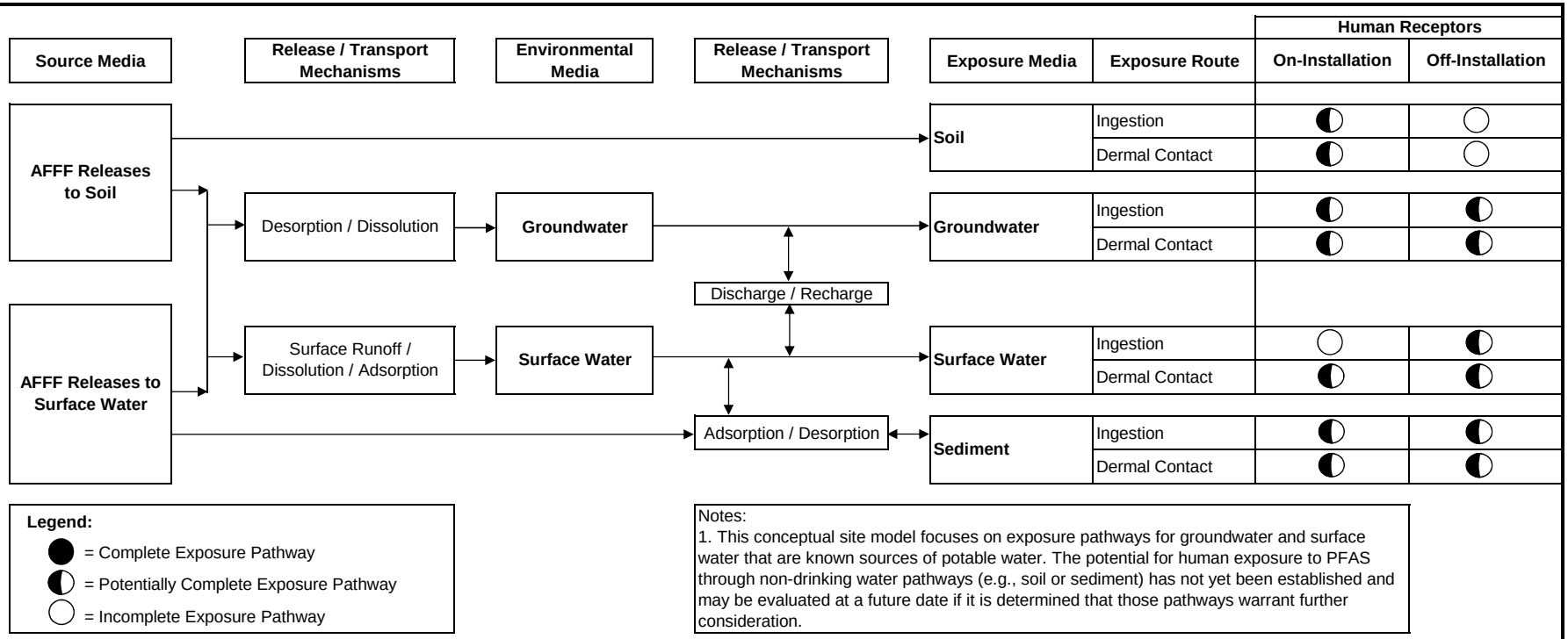
Conceptual Site Model for Drinking Water Pathway - AOPI Building 3316 - Firehouse 2
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 10



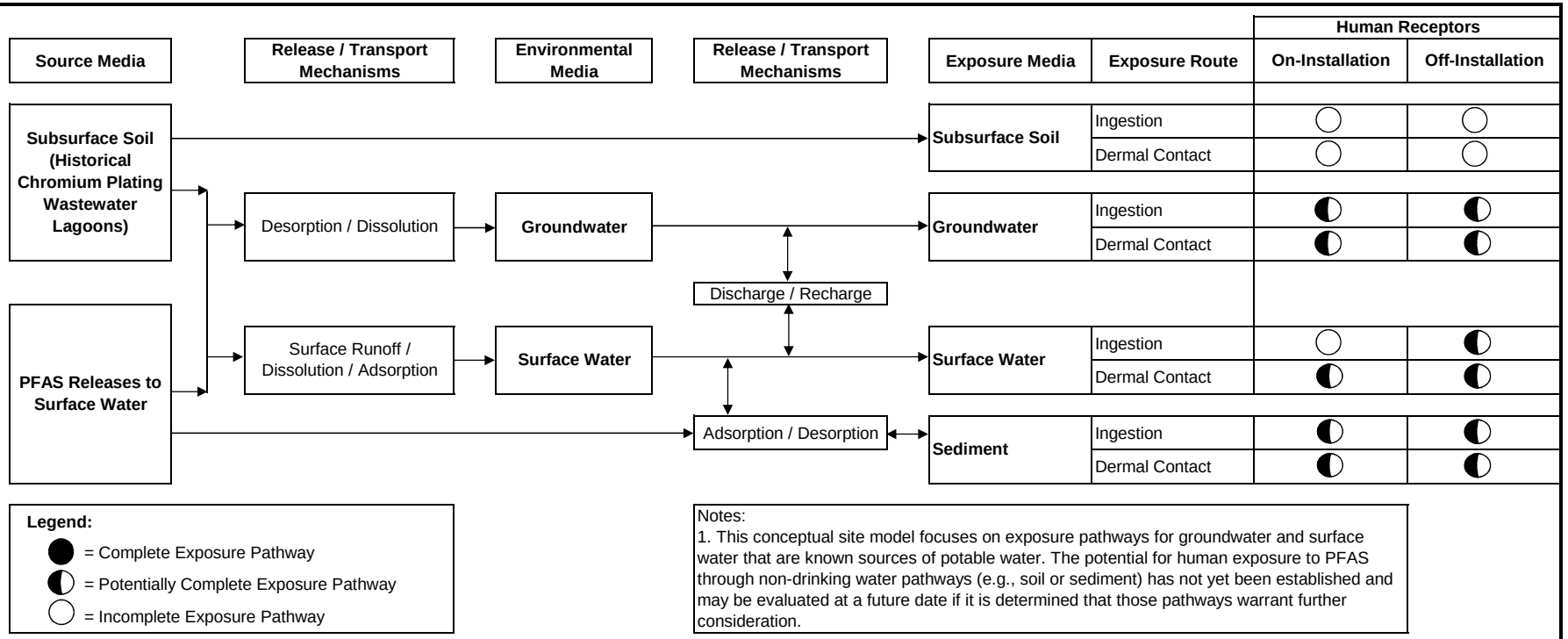
Conceptual Site Model for Drinking Water Pathway - AOPI Lawn to the North of Building 3409/3410
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 11



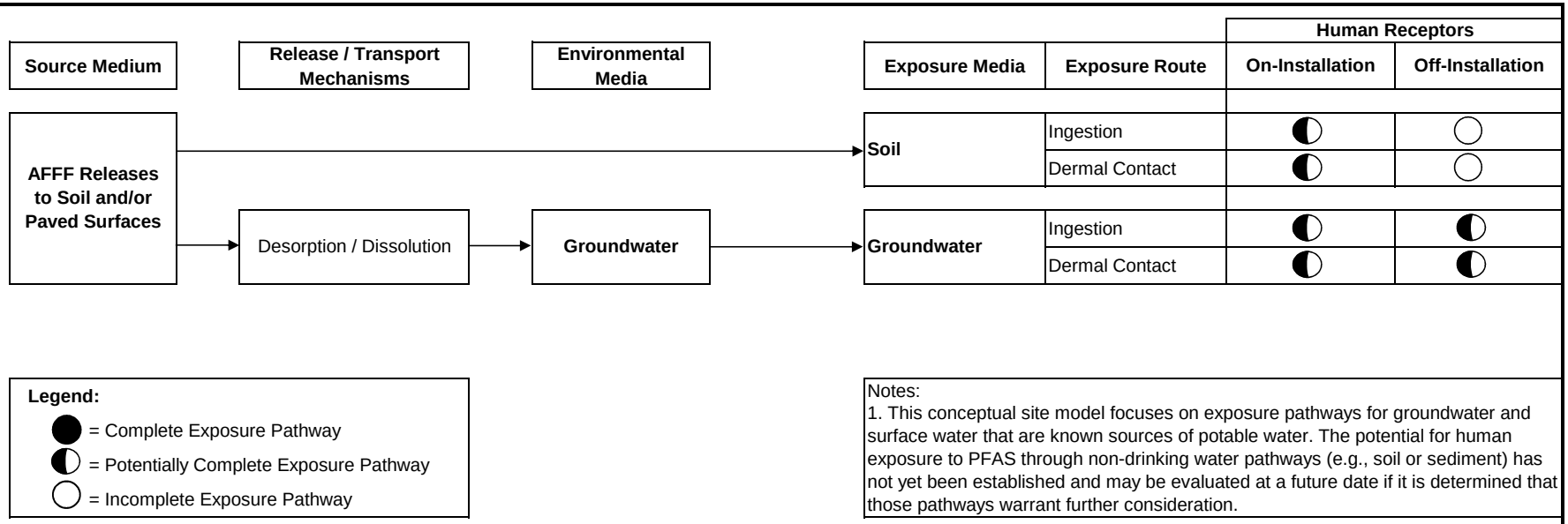
Conceptual Site Model for Drinking Water Pathway - AOPI Area 1222 - Gorge
USAEC PFAS Preliminary Assessment
Picatinny Arsenal, NJ

Figure 12



Conceptual Site Model for Drinking Water Pathway - AOPI Former Building 24
USAEC PFAS Preliminary Assessment
Picatinny Arsenal, NJ

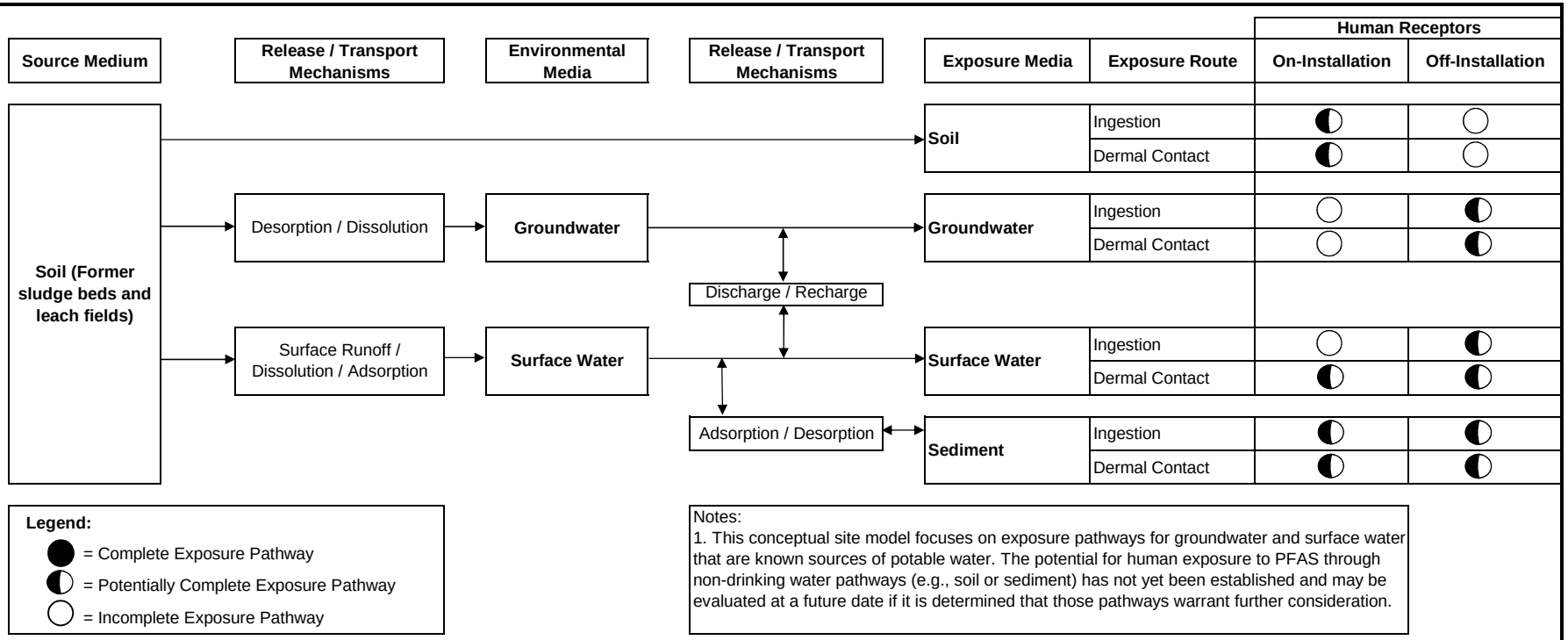
Figure 13



ARCADIS

Conceptual Site Model for Drinking Water Pathway - AOPI Building 169 - Firehouse 1
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

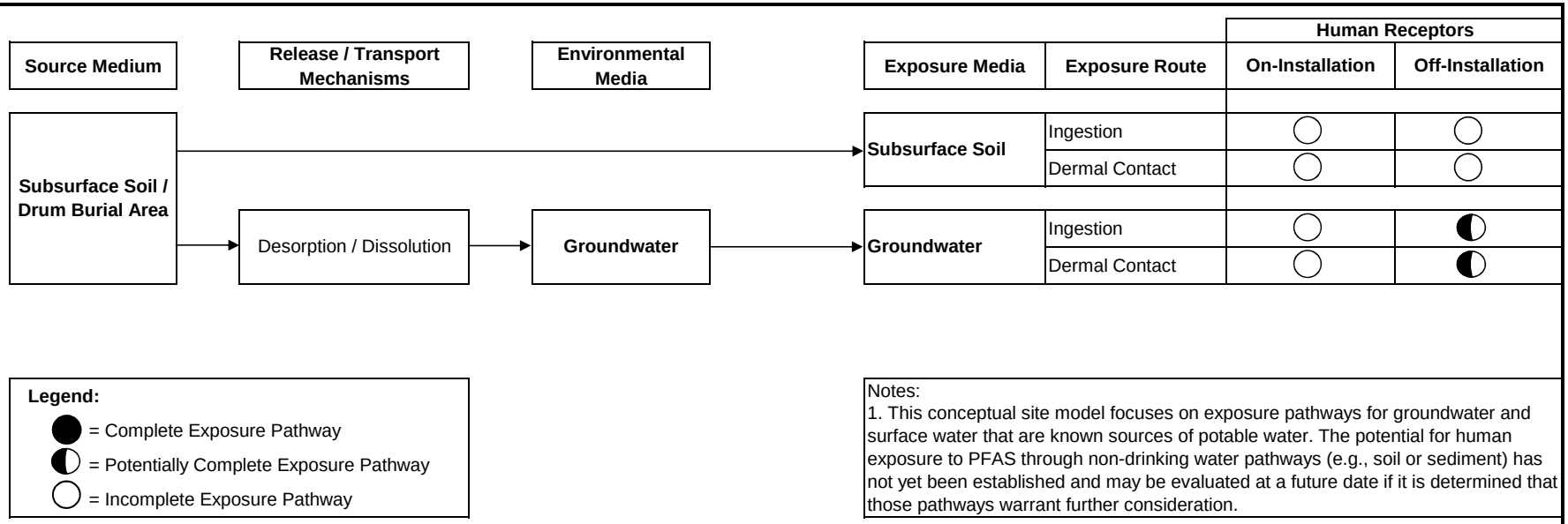
Figure 14



ARCADIS

Conceptual Site Model for Drinking Water Pathway - AOPI Former WWTP Facility
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 15



Legend:

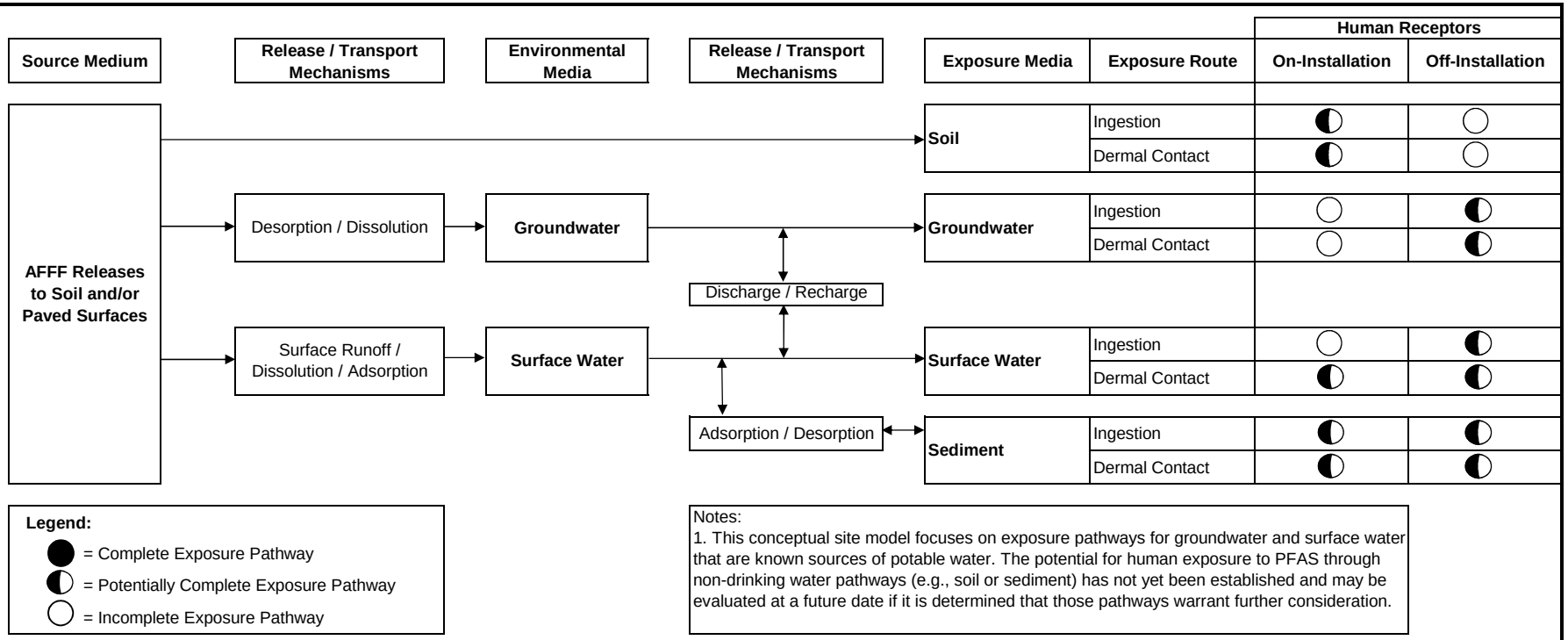
- = Complete Exposure Pathway
- = Potentially Complete Exposure Pathway
- = Incomplete Exposure Pathway

Notes:
1. This conceptual site model focuses on exposure pathways for groundwater and surface water that are known sources of potable water. The potential for human exposure to PFAS through non-drinking water pathways (e.g., soil or sediment) has not yet been established and may be evaluated at a future date if it is determined that those pathways warrant further consideration.

ARCADIS

Conceptual Site Model for Drinking Water Pathway - AOPI Post Farm Landfill
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 16



ARCADIS

Conceptual Site Model for Drinking Water Pathway - AOPI Building 3801 - NJARNG Helipad Area
USAEC PFAS Preliminary Assessment / Site Inspection
Picatinny Arsenal, NJ

Figure 17

Attachment 1

Off-Site Well Details

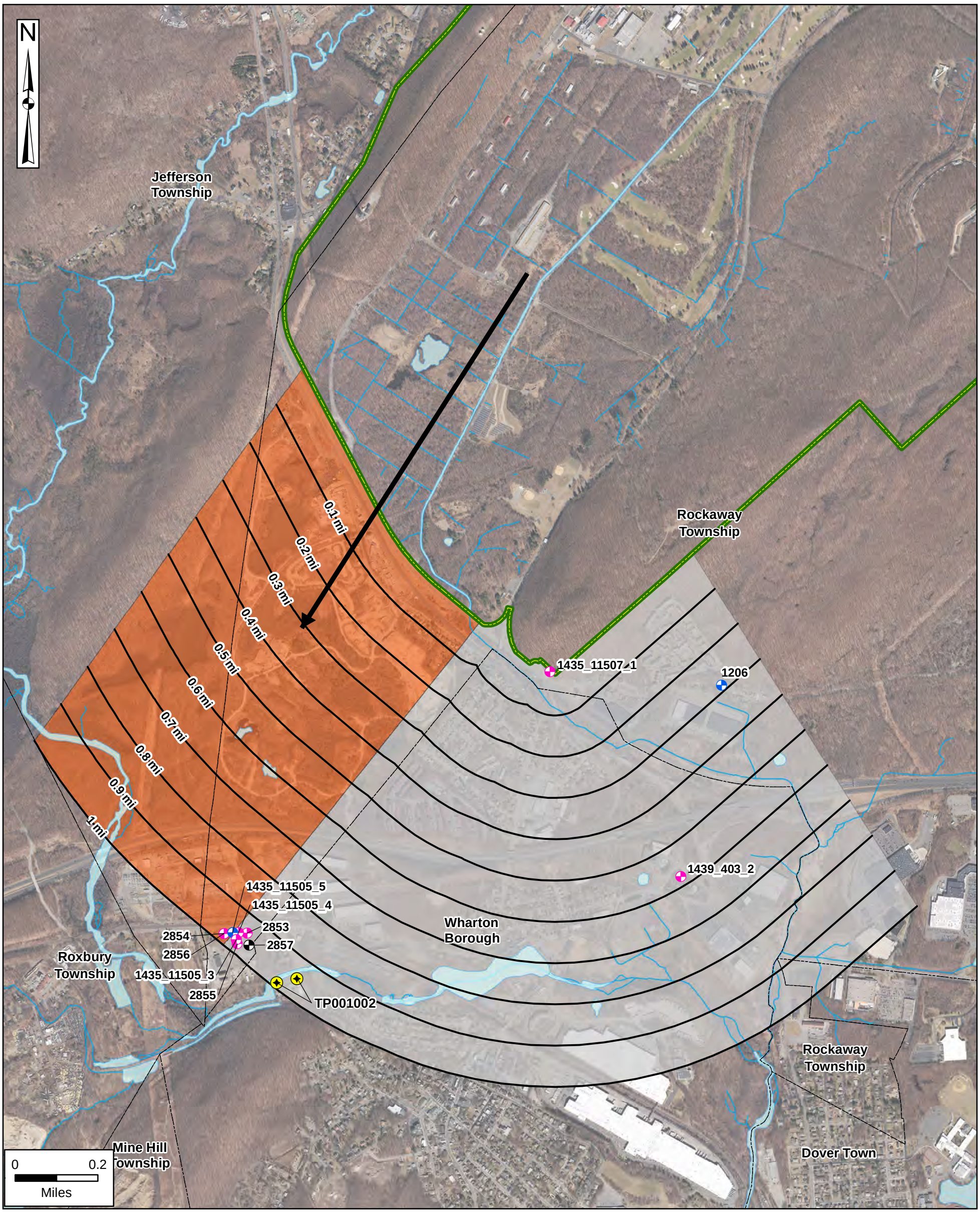
Attachment 1
Picatinny SI QAPP Addendum
Off-Site Well Details

Well Figure ID	Well Permit No	Block	Lot	Municipality	Easting	Northing	Distance from southern boundary (miles)	Total Depth (feet)	Diameter Top of Well (inches)	Diameter Bottom of Well (inches)	Casing material	Boring Log Information	Well Status
1435_11507_1	NA (Rockaway Township identified well; well record not reviewed)	11507	1	Rockaway Township	470469.2948	758021.1604	0.01	NA	NA	NA	NA	NA	Well identified and sampled (sampled 8/14/19)
1206	2500003681	11508	4	Rockaway Township	472664.4065	757841.234	0.29	71	6	6	Steel	log recorded on permit is illegible	Well Identified; Owner mailed/property visited - no questionnaire/access response
1439_403_2	NA (Wharton Borough identified well; well record not reviewed)	403	2	Wharton Borough	472129.4688	755394.131	0.58	NA	NA	NA	NA	NA	Well Identified and sampled (sampled 5/15/19 & 7/3/19)
2853	2500016185	11506	2	Rockaway Township	466576.727	754703.1018	0.94	134	NA	NA	Steel	0 - 46' Sand, gravel; 46' - 134' Clay	Well identified and sampled (sampled 8/13/19)
1435_11505_4	NA (Wharton Borough identified well; well record not reviewed)	11505	4	Rockaway Township	466465.4696	754712.9867	0.95	NA	NA	NA	NA	NA	Well identified and sampled (sampled 8/13/19)
2857	2500029370	11506	5	Rockaway Township	466601.0737	754544.6368	0.96	280	10	6	Steel	0 - 45' Gravel; 45' - 174' Sand, 174' - 280' Granite	Possible well identified; Owner received letter/property visited - no questionnaire/access response
1435_11505_5	NA (Rockaway Township identified well; well record not reviewed)	11505	5	Rockaway Township	466390.4407	754706.03	0.96	NA	NA	NA	NA	NA	Well identified by Township; Owner mailed/owner's residence visited - no questionnaire/access response
1435_11505_3	NA (Owner identified well; well record not reviewed)	11505	3	Rockaway Township	466435.9958	754616.0487	0.97	NA	NA	NA	NA	NA	Well identified and sampled (sampled 8/13/19)
2855	2500018916	11505	2	Rockaway Township	466447.5079	754566.0114	0.98	120	6	6	Steel	Sand & gravel overburden	Well identified and sampled (sampled 8/13/19)
2854	2500016470 (Year 1972)	11505	6	Rockaway Township	466280.5904	754698.8348	0.98	100	6	NA	Steel	0 - 15' Clay & Gravel; 46' - 100' Sand & Gray Clay	Well identified and sampled (sampled 8/14/19)
2856	2500021618 (Year 1980)							30	6	6	17# drive	Hand dug well to 15', sand & gravel with large stones to water bearing sand & gravel to bottom at 30'.	Well identified and sampled (sampled 8/14/19)

NA - Information not available or not recorded

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 18
Off-Site Well Locations



Installation Boundary
Southern Downgradient Area
Southeast Downgradient Area
Groundwater Flow Direction
Municipal Boundary

Potable Well - Sampled
Potable Well - Identified
Possible Well Identified. Owner has been provided questionnaire
Public Supply Well - Sampled

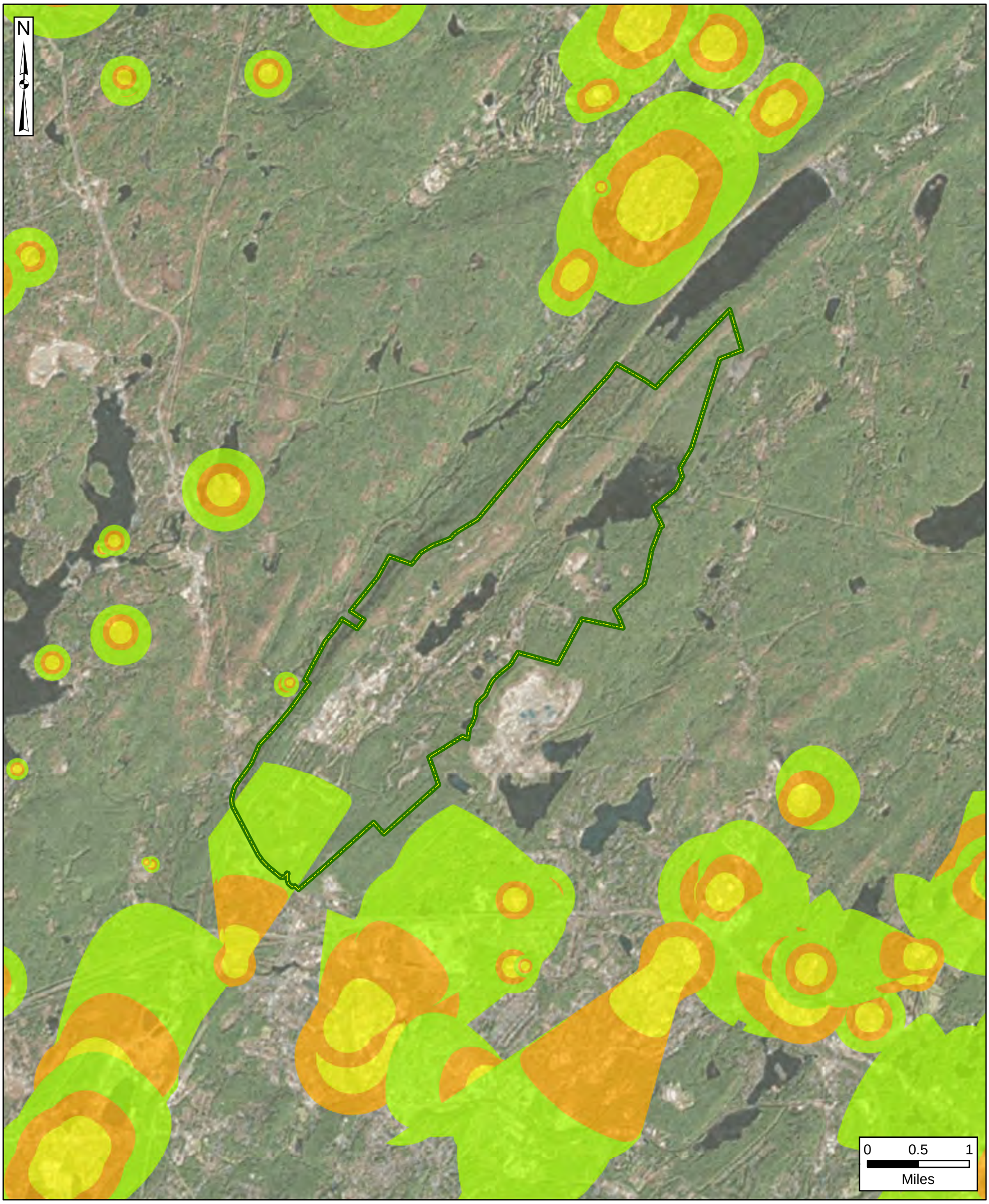
Note: Wharton Public Supply Well (TP001002) sampled by Wharton Borough. The TP001002 represents two well locations. The wells are connected to a single air stripping tower, so they are combined under one designation.

* wells identified within 1 mile radius hydraulically downgradient of Picatinny Arsenal

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 19
Community Well Head Protection Areas



Installation Boundary

Time of Travel*

2 Year

5 Year

12 Year

* Indicates the area a well draws water from within a specified time frame.

Data Sources:
Picatinny Arsenal, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 20
AOPI Former Pyrotechnic Area

AOPI Location
AFFF Use Area
Potential PFAS Release/Spray Field
Well
Well (Abandoned / Not Located)
River/Stream
Water Body
Assumed Groundwater Flow Direction

Note:
Pre-SI sampling indicated PFOS/PFOA concentrations found above Health Advisory Level (HAL).

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 21
AOPI Former Building 24

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

ARCADIS

Figure 22
AOPI Building 169 - Firehouse 1

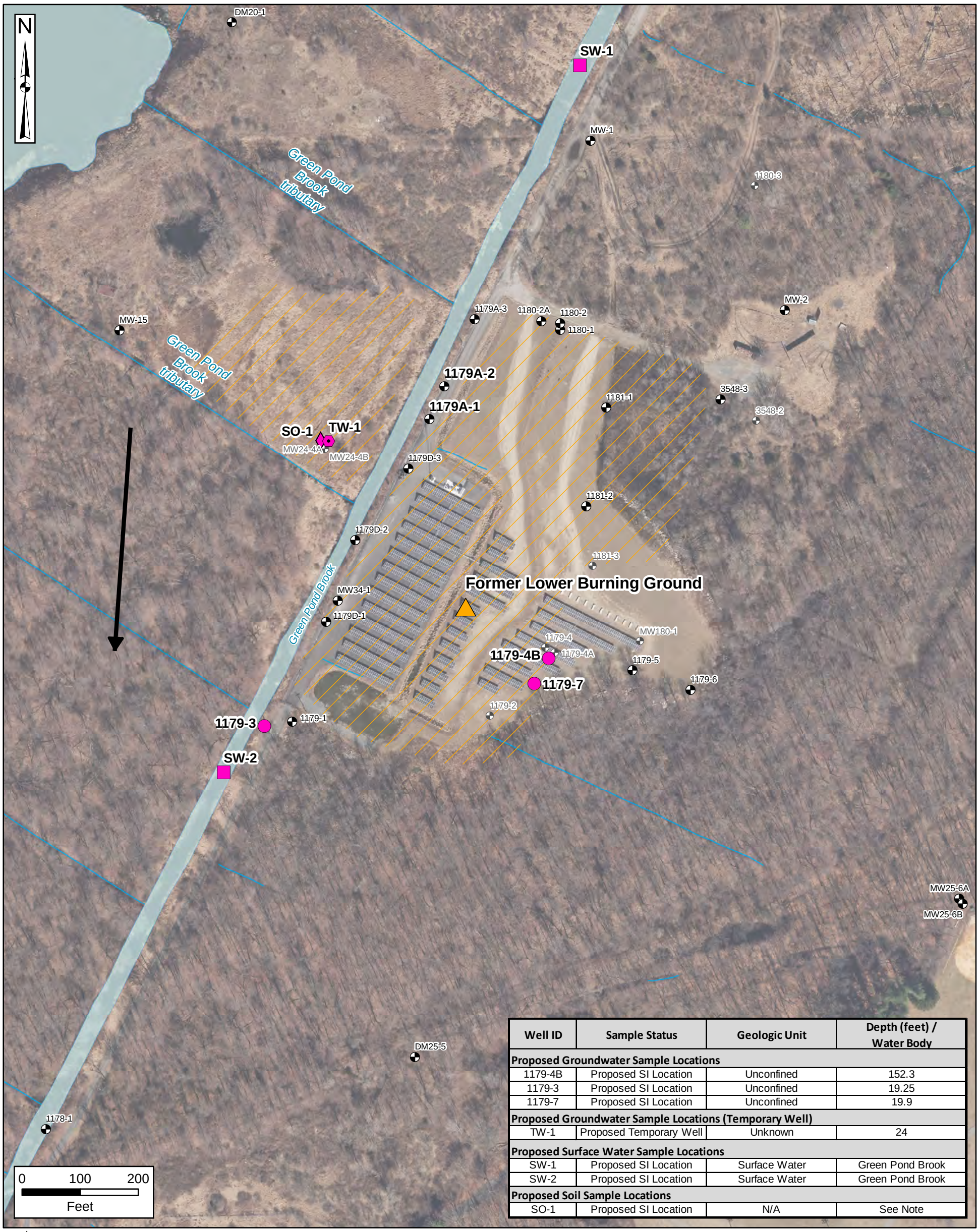
AOPI Location
AFFF Use Area
Well
Well (Abandoned / Not Located)
River/Stream
Assumed Groundwater Flow Direction

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

ARCADIS

Figure 23
AOPI Former Lower Burning Grounds and Sanitary Landfill
Proposed Sampling Locations



Well ID	Sample Status	Geologic Unit	Depth (feet) / Water Body
Proposed Groundwater Sample Locations			
1179-4B	Proposed SI Location	Unconfined	152.3
1179-3	Proposed SI Location	Unconfined	19.25
1179-7	Proposed SI Location	Unconfined	19.9
Proposed Groundwater Sample Locations (Temporary Well)			
TW-1	Proposed Temporary Well	Unknown	24
Proposed Surface Water Sample Locations			
SW-1	Proposed SI Location	Surface Water	Green Pond Brook
SW-2	Proposed SI Location	Surface Water	Green Pond Brook
Proposed Soil Sample Locations			
SO-1	Proposed SI Location	N/A	See Note

AOPI Location
AFFF Use Area
Well
Well (Abandoned / Not Located)
River/Stream
Water Body
Assumed Groundwater Flow Direction

Groundwater Sampling Locations
Proposed Sample Location for SI
Proposed sample location for SI (Temporary Well)

Surface Water Sampling Locations
Proposed Sample Location for SI

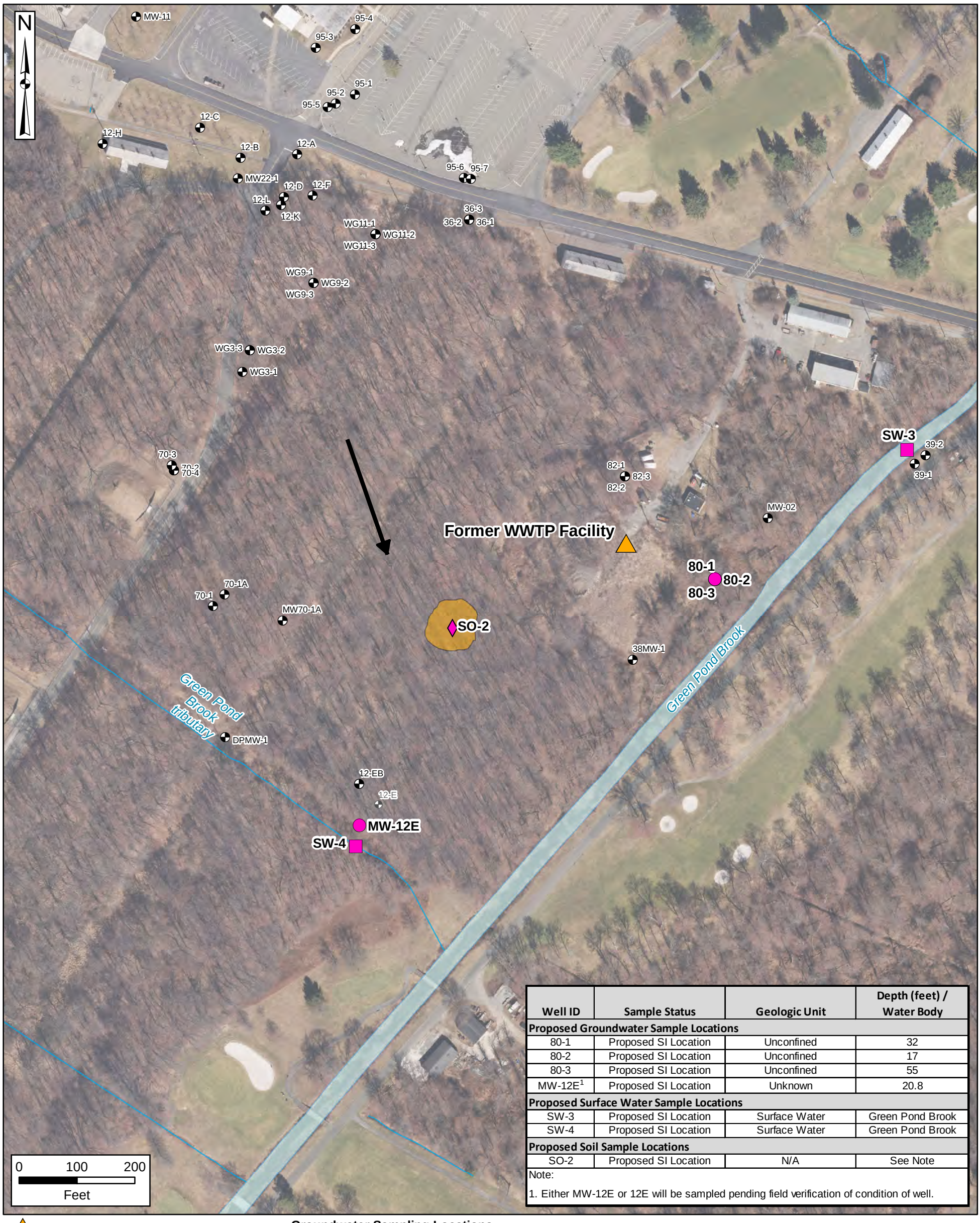
Soil Boring Sampling Locations
Proposed Sample Location for SI

Note:
Soil samples will be collected near surface and within the capillary zone (just above water table). Areas where AFFF use was confirmed and a temporary well (TW) is proposed, a soil sample will be co-located. Soil sample will be collected from SO-1 which will be co-located withTW-1 borehole. Location will be selected based on field conditions. A SW sample will be collected if stream is flowing during the sampling event.

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 24
AOPI Former WWTP Facility
Proposed Sampling Locations



Well ID	Sample Status	Geologic Unit	Depth (feet) / Water Body
Proposed Groundwater Sample Locations			
80-1	Proposed SI Location	Unconfined	32
80-2	Proposed SI Location	Unconfined	17
80-3	Proposed SI Location	Unconfined	55
MW-12E[1]	Proposed SI Location	Unknown	20.8
Proposed Surface Water Sample Locations			
SW-3	Proposed SI Location	Surface Water	Green Pond Brook
SW-4	Proposed SI Location	Surface Water	Green Pond Brook
Proposed Soil Sample Locations			
SO-2	Proposed SI Location	N/A	See Note

Note:
1. Either MW-12E or 12E will be sampled pending field verification of condition of well.

AOPI Location
Approximate Location of Leach Fields
Well
Well (Abandoned / Not Located)
Assumed Groundwater Flow Direction
River/Stream
Water Body

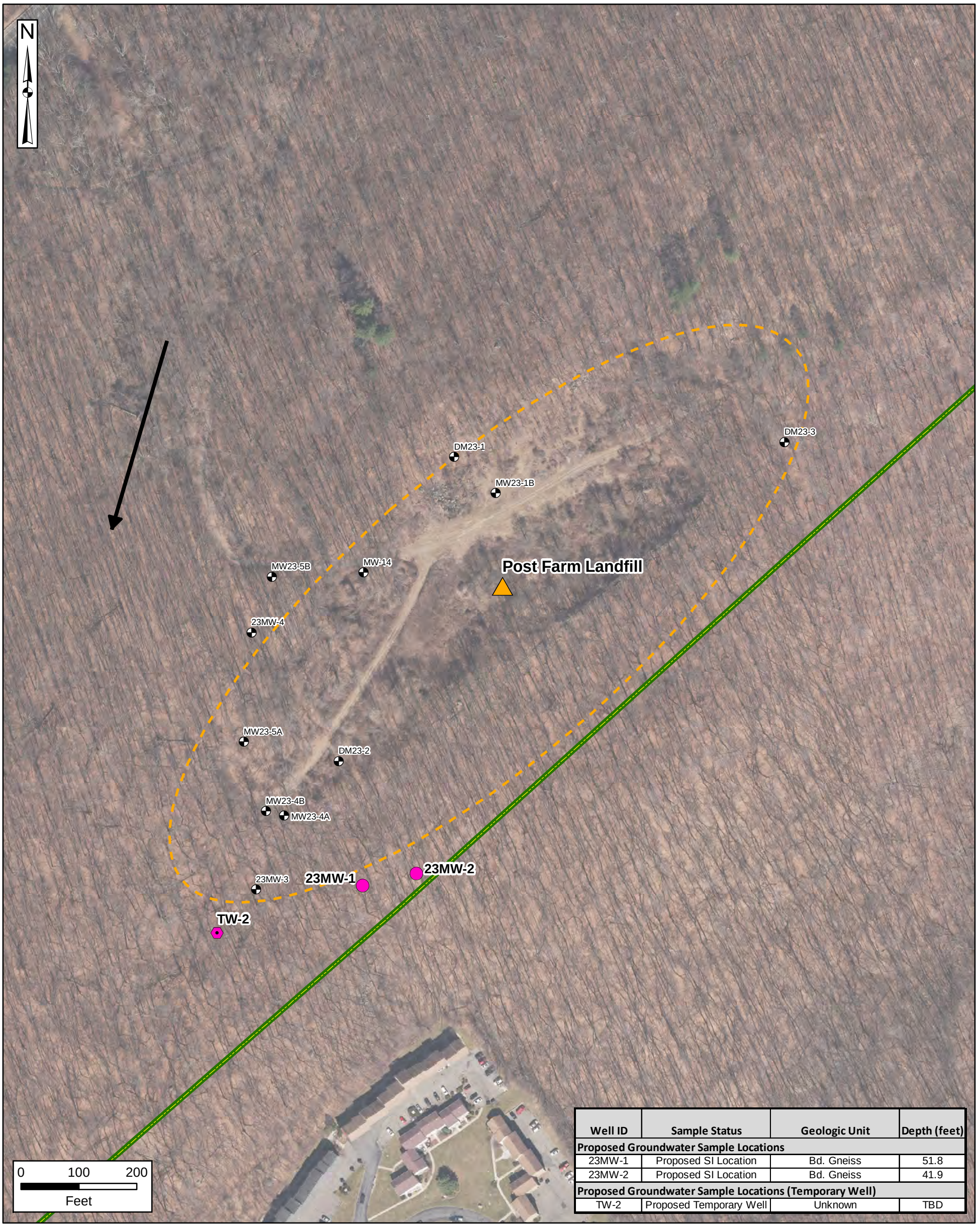
Groundwater Sampling Locations
Proposed Sample Location for SI
Surface Water Sampling Locations
Proposed Sample Location for SI
Soil Boring Sampling Locations
Proposed Sample Location for SI

Note:
Soil samples will be collected near surface and within the capillary zone (just above water table). The drill rig may not be able to access the soil sample location. If the location cannot be accessed only a surface soil sample will be collected. A SW sample will be collected if stream is flowing during the sampling event.

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 25
AOPI Post Farm Landfill
Proposed Sampling Locations



Well ID	Sample Status	Geologic Unit	Depth (feet)
Proposed Groundwater Sample Locations			
23MW-1	Proposed SI Location	Bd. Gneiss	51.8
23MW-2	Proposed SI Location	Bd. Gneiss	41.9
Proposed Groundwater Sample Locations (Temporary Well)			
TW-2	Proposed Temporary Well	Unknown	TBD

Installation Boundary
AOPI Location
Approx. Historical Dumping Area
Well
Assumed Groundwater Flow Direction

Groundwater Sampling Locations
Proposed Sample Location for SI
Proposed Sample Location for SI (Temporary Well)

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 26
AOPI Building 3316 - Firehouse 2
Proposed Sampling Locations

Well ID	Sample Status	Geologic Unit	Depth (feet)
Proposed Groundwater Sample Locations			
3316-1	Proposed SI Location	Unknown	70.1
3316-3	Proposed SI Location	Unknown	20.7
Proposed Groundwater Sample Locations (Temporary Well)[1]			
TW-3	Proposed Temporary Well	Unknown	TBD
Proposed Soil Sample Locations			
SO-3	Proposed SI Location	N/A	See Note

AOPI Location
AFFF Use Area
Well
Well (Abandoned / Not Located)
Assumed Groundwater Flow Direction

Groundwater Sampling Locations
Proposed Sample Location for SI
Proposed Sample Location for SI (Temporary Well)

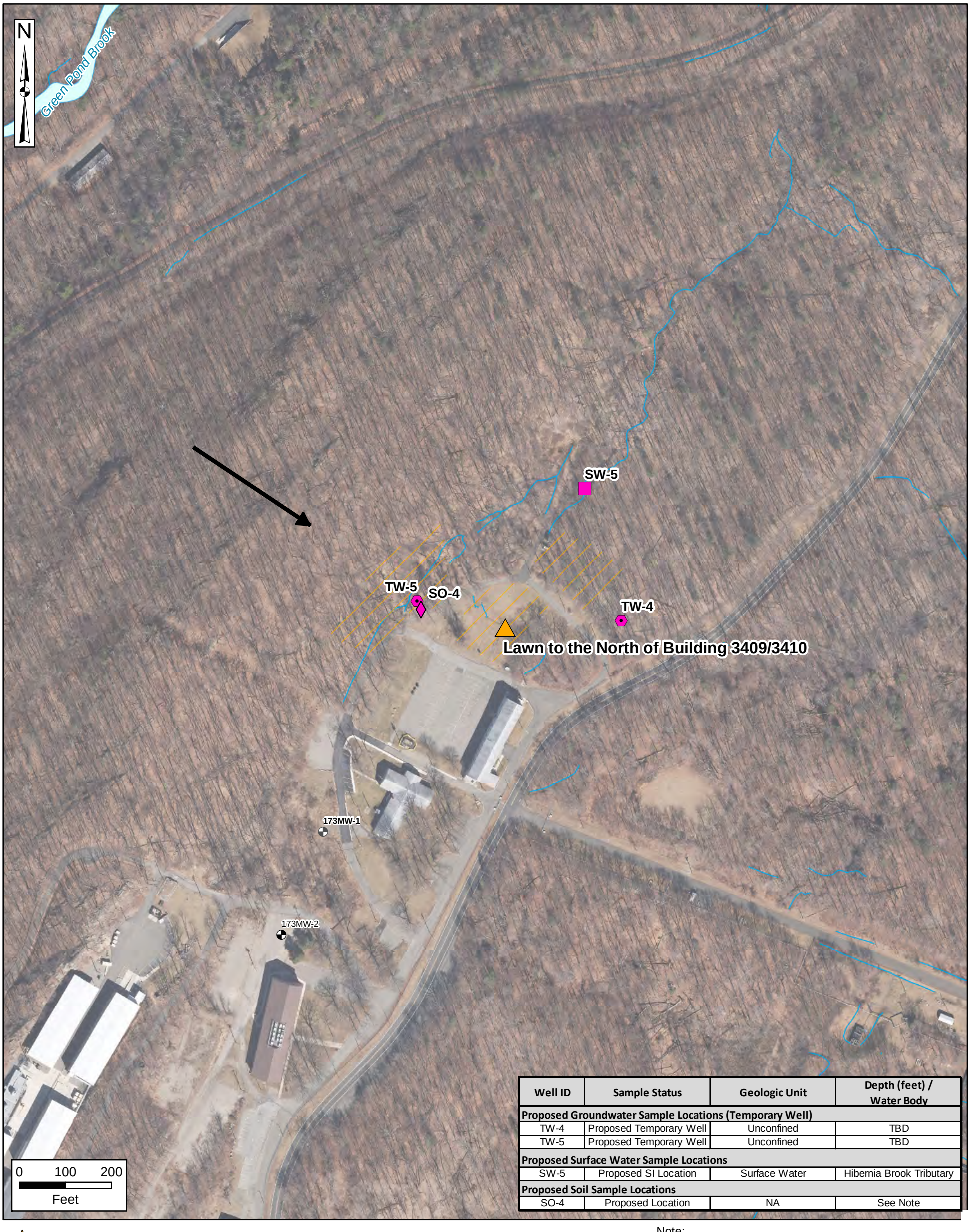
Soil Boring Sampling Locations
Proposed Sample Location for SI

Note:
Soil samples will be collected near surface and within the capillary zone (just above water table). Areas where AFFF use was confirmed and a temporary well (TW) is proposed, a soil sample will be co-located. Soil sample location will be downgradient from the identified AFFF use area and co- located with TW-3. Field verification of sheet flow from the identified AFFF use area will determine final location.

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 27
AOPI Lawn to the North of Building 3409/3410
Proposed Sampling Locations



Well ID	Sample Status	Geologic Unit	Depth (feet) / Water Body
Proposed Groundwater Sample Locations (Temporary Well)			
TW-4	Proposed Temporary Well	Unconfined	TBD
TW-5	Proposed Temporary Well	Unconfined	TBD
Proposed Surface Water Sample Locations			
SW-5	Proposed SI Location	Surface Water	Hibernia Brook Tributary
Proposed Soil Sample Locations			
SO-4	Proposed Location	NA	See Note

AOPI Location
AFFF Use Area
River/Stream
Well
Well (Abandoned / Not Located)
Assumed Groundwater Flow Direction

Groundwater Sampling Locations
Proposed Sample location for SI (Temporary Well)

Surface Water Sampling Locations
Proposed Sample Location for SI

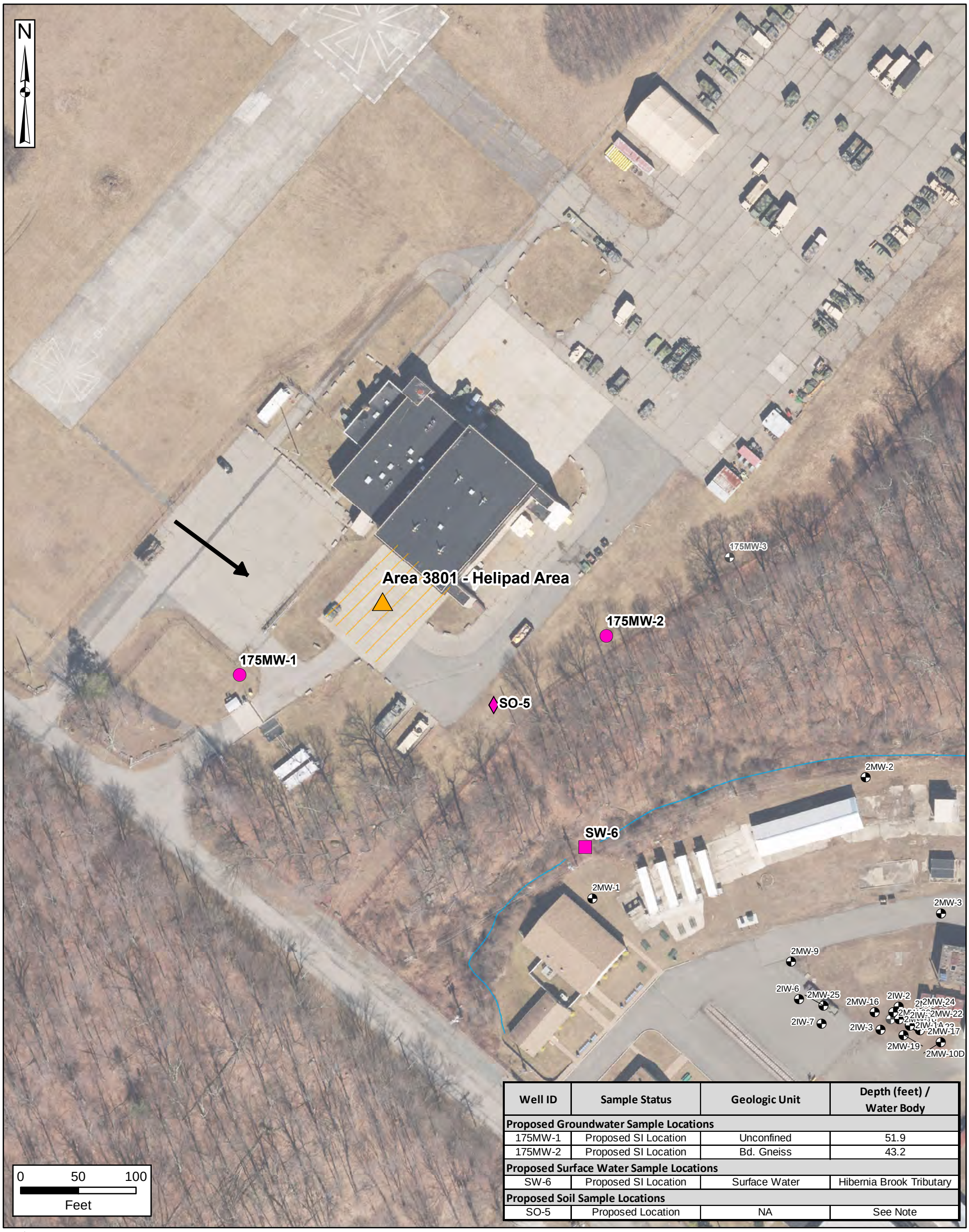
Soil Boring Sampling Locations
Proposed Sample Location for SI

Note:
Soil samples will be collected near surface and within the capillary zone (just above water table). Areas where AFFF use was confirmed and a temporary well (TW) is proposed, a soil sample will be co-located. Soil sample SO-4 will be co-located with TW-5. A SW sample will be collected if stream is flowing during the sampling event.

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 28
AOPI Building 3801 – NJARNG Helipad Area
Proposed Sampling Locations



Well ID	Sample Status	Geologic Unit	Depth (feet) / Water Body
Proposed Groundwater Sample Locations			
175MW-1	Proposed SI Location	Unconfined	51.9
175MW-2	Proposed SI Location	Bd. Gneiss	43.2
Proposed Surface Water Sample Locations			
SW-6	Proposed SI Location	Surface Water	Hibernia Brook Tributary
Proposed Soil Sample Locations			
SO-5	Proposed Location	NA	See Note

AOPI Location
AFFF Use Area
River/Stream
Well
Well (Abandoned / Not Located)
Assumed Groundwater Flow Direction

Groundwater Sampling Locations
Proposed Sample Location for SI

Surface Water Sampling Locations
Proposed Sample Location for SI

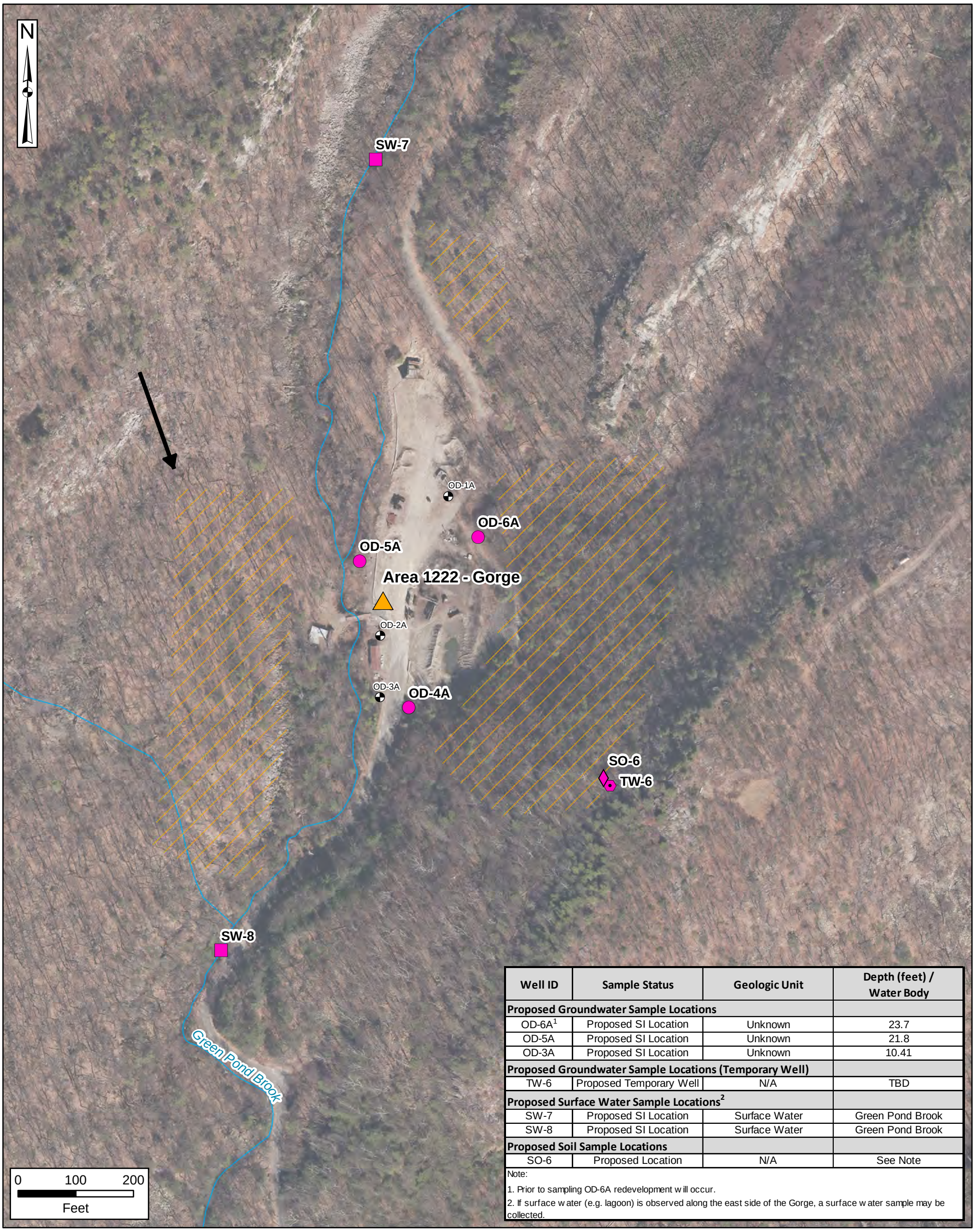
Soil Boring Sampling Locations
Proposed Sample Location for SI

Note:
Soil samples will be collected near surface and within the capillary zone (just above water table). Soil sample location will be downgradient from the identified AFFF use area, field verification of sheet flow from the identified AFFF use area will determine final location. A SW sample will be collected if stream is flowing during the sampling event

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 29
AOPI Area 1222 - Gorge
Proposed Sampling Locations



Well ID	Sample Status	Geologic Unit	Depth (feet) / Water Body
Proposed Groundwater Sample Locations			
OD-6A[1]	Proposed SI Location	Unknown	23.7
OD-5A	Proposed SI Location	Unknown	21.8
OD-3A	Proposed SI Location	Unknown	10.41
Proposed Groundwater Sample Locations (Temporary Well)			
TW-6	Proposed Temporary Well	N/A	TBD
Proposed Surface Water Sample Locations[2]			
SW-7	Proposed SI Location	Surface Water	Green Pond Brook
SW-8	Proposed SI Location	Surface Water	Green Pond Brook
Proposed Soil Sample Locations			
SO-6	Proposed Location	N/A	See Note

Note:
1. Prior to sampling OD-6A redevelopment will occur.
2. If surface water (e.g. lagoon) is observed along the east side of the Gorge, a surface water sample may be collected.

AOPI Location
AFFF Use Area
Well
River/Stream
Assumed Groundwater Flow Direction

Soil Boring Sampling Locations
Proposed Sample Location for SI

Groundwater Sampling Locations
Proposed Sample location for SI
Proposed Sample Location for SI (Temporary Well)

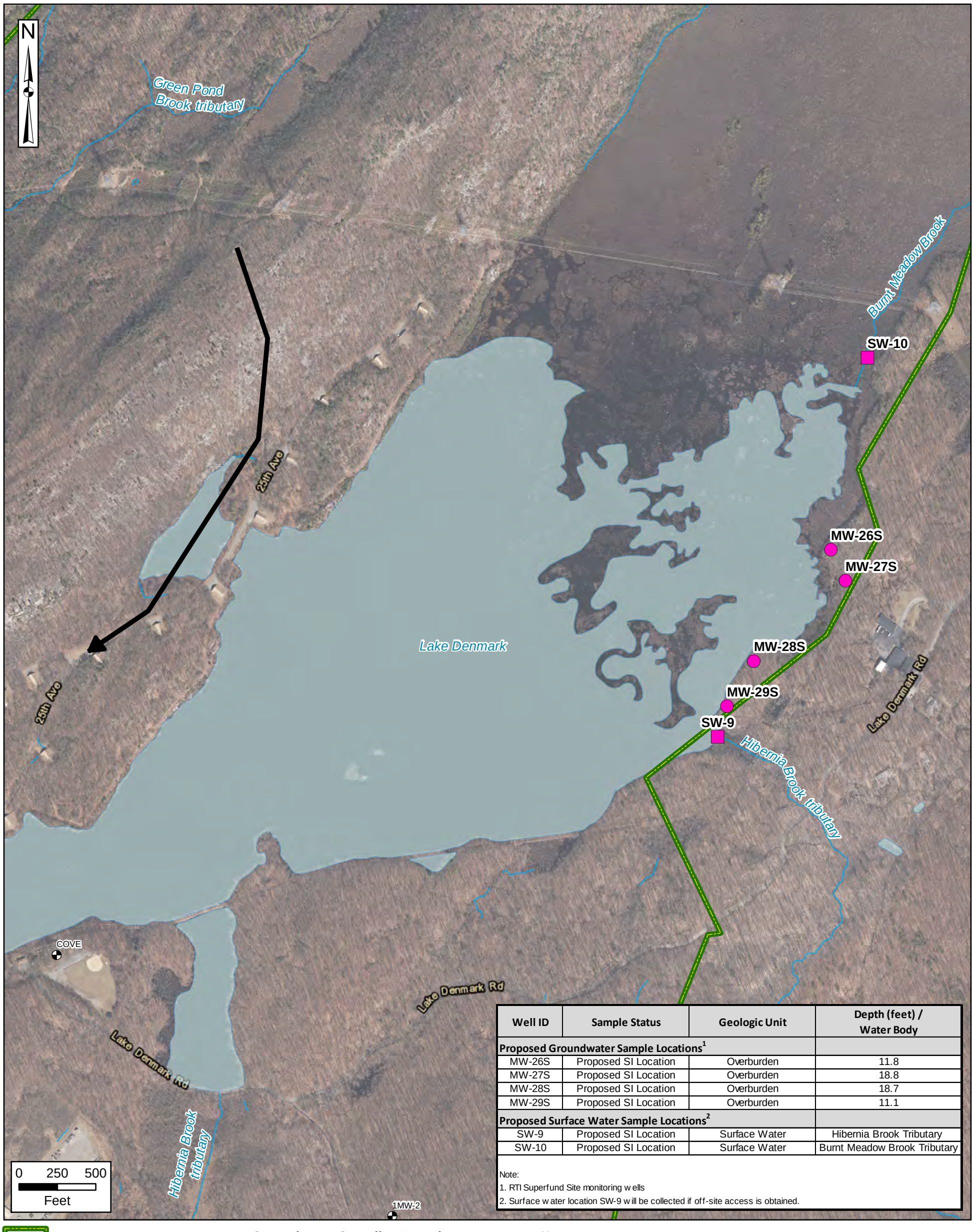
Surface Water Sampling Locations
Proposed Sample Location for SI

Note:
Soil samples will be collected near surface and within the capillary zone (just above water table). Areas where AFFF use was confirmed and a temporary well (TW) is proposed, a soil sample will be co-located. A SW sample will be collected if stream is flowing during the sampling event.

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 30
Eastern Boundary - On-Site
Proposed Sample Locations



Well ID	Sample Status	Geologic Unit	Depth (feet) / Water Body
Proposed Groundwater Sample Locations[1]			
MW-26S	Proposed SI Location	Overburden	11.8
MW-27S	Proposed SI Location	Overburden	18.8
MW-28S	Proposed SI Location	Overburden	18.7
MW-29S	Proposed SI Location	Overburden	11.1
Proposed Surface Water Sample Locations[2]			
SW-9	Proposed SI Location	Surface Water	Hibernia Brook Tributary
SW-10	Proposed SI Location	Surface Water	Burnt Meadow Brook Tributary

Note:
1. RTI Superfund Site monitoring wells
2. Surface water location SW-9 will be collected if off-site access is obtained.

Installation Boundary
River/Stream
Water Body
Groundwater Flow Direction
Well

Groundwater Sampling Locations
Proposed Sample Location for SI

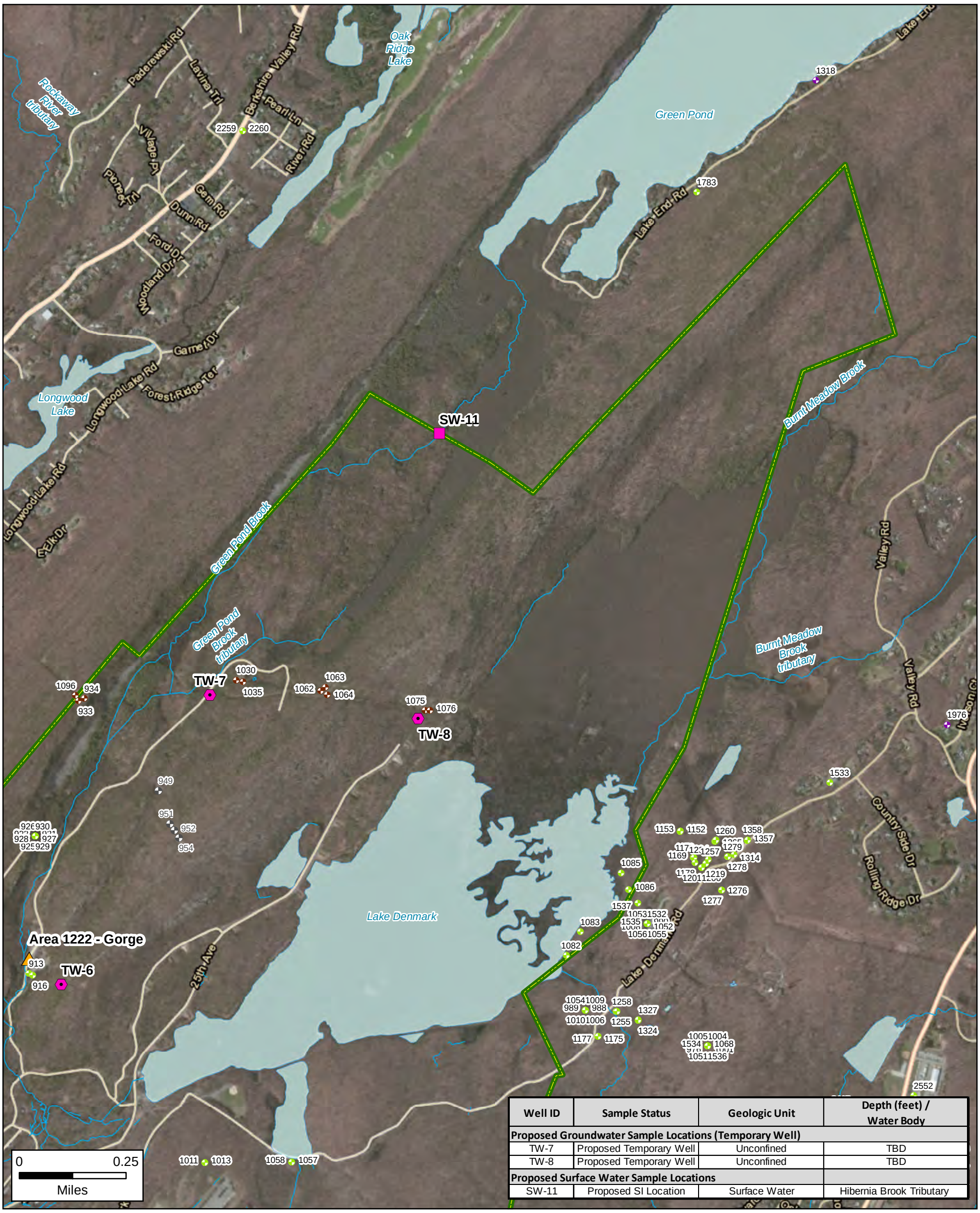
Surface Water Sampling Locations
Proposed Sample Location for SI

Note:
A SW sample will be collected if stream is flowing during the sampling event.

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 31
Northern Boundary
Proposed Sampling Locations



Well ID	Sample Status	Geologic Unit	Depth (feet) / Water Body
Proposed Groundwater Sample Locations (Temporary Well)			
TW-7	Proposed Temporary Well	Unconfined	TBD
TW-8	Proposed Temporary Well	Unconfined	TBD
Proposed Surface Water Sample Locations			
SW-11	Proposed SI Location	Surface Water	Hibernia Brook Tributary

Installation Boundary
AOPI Location
Water Body
River/Stream

Environmental Well - Not Potentially Potable
Geothermal Well - Not Potentially Potable
Industrial Well - Not Potentially Potable
Well (Abandoned)

Groundwater Sampling Locations

Proposed Sample Location for SI (Temporary Well)

Surface Water Sampling Locations

Proposed Sample Location for SI

Note:
A SW sample will be collected if stream is flowing during the sampling event.

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 32
Mid-Valley Upgradient On-Site
Proposed Sampling Locations

Well ID	Sample Status	Geologic Unit	Depth (feet) / Water Body
Proposed Groundwater Sample Locations			
171MW-12	Proposed SI Location	Bedrock	140-160

- Installation Boundary
- AOPI Location
- AFFF Use Area
- River/Stream
- Water Body
- Elevation Contour (Index) (ft)
- Elevation Contour (Intermediate) (ft)
- Well
- Well (Abandoned / Not Located)

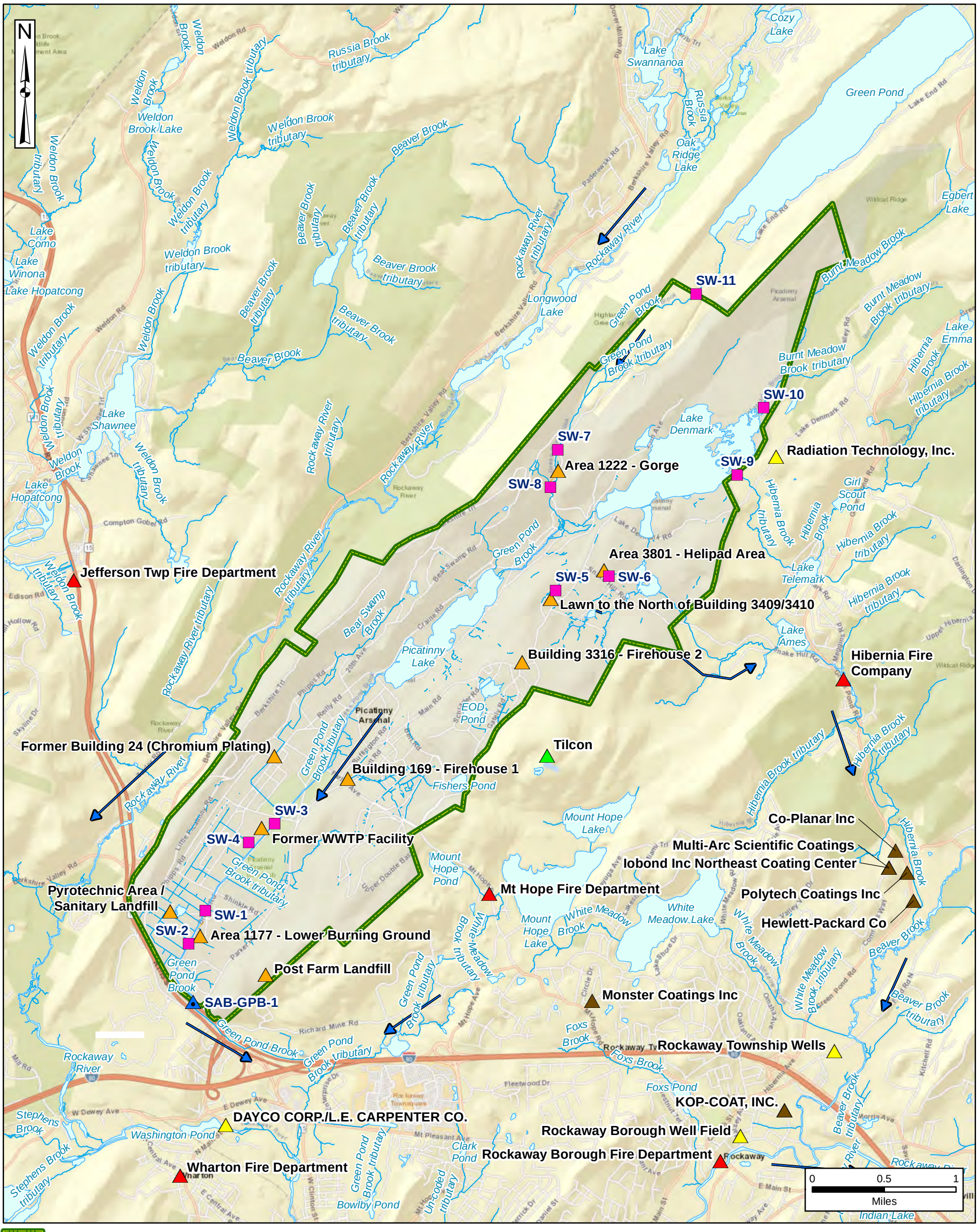
Groundwater Sampling Locations

- Proposed Sample Location for SI

Coordinate System:
WGS 1984, UTM Zone 18 North

Quality Assurance Project Plan Addendum
USAEC PFAS Site Inspection
Picatinny Arsenal, NJ

Figure 33
Proposed Site-Wide
Surface Water Sample Locations



Coordinate System:
WGS 1984, UTM Zone 18 North

Attachment 2

Off-Site Well Logs

This PDF Package contains multiple files grouped together within a single container PDF file.

Kofax Power PDF can be used to view, create and manage the files within this container.

To get started, click any file in the PDF Portfolio to view it.

- PDF Packages group multiple files and file types together to make them easier to distribute or share.
- PDF Packages allow you to organize related files for easier viewing and printing
- PDF Packages maintain the original security settings of the files or folders included in the container

Note: In older viewers/editors the files are stored as attachments to this page.

Attachment 3

Site Safety and Health Plan (provided under separate cover)

Attachment 4

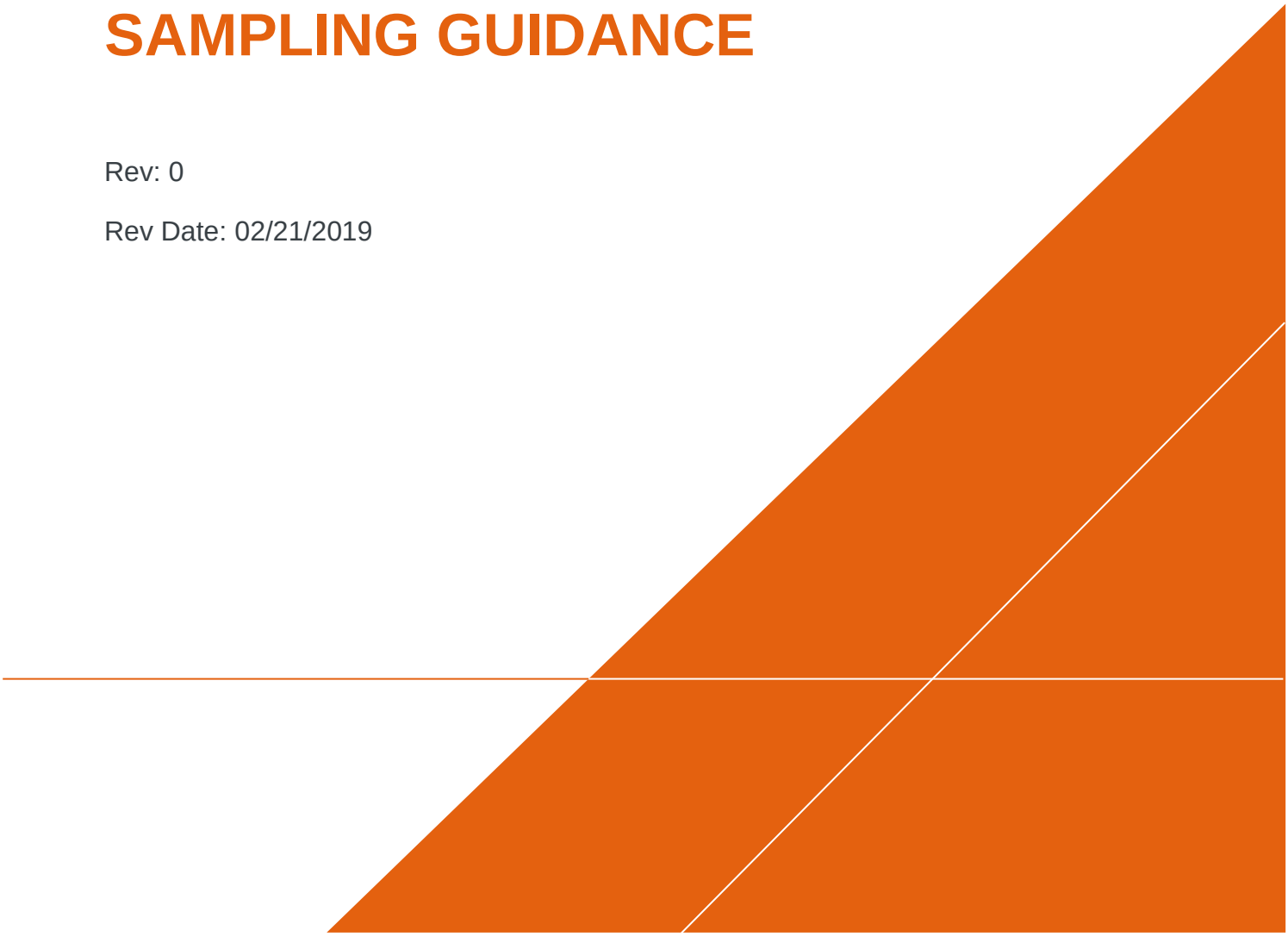
Off-Site Well Sampling SOP

ARCADIS Design & Consultancy for natural and built assets

TGI - DOMESTIC WELL SAMPLING POLY- AND PERFLUORINATED ALKYL SUBSTANCES (PFAS) FIELD SAMPLING GUIDANCE

Rev: 0

Rev Date: 02/21/2019



VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	02, 21, 2019			Technical Expert Name Procedure Librarian Name

APPROVAL SIGNATURES

Prepared by:	Insert signature here	02/19/2019
	Eric Killenbeck	Date:
Reviewed by:	Insert signature here	02/19/2019
	Lisa Szegedi	Date:

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

The purpose of this Technical Guidance Instructions (TGI) is to provide guidance on domestic well sampling for poly-and perfluorinated alkyl substances (PFAS) in private wells.

Given the extremely low detection limits associated with PFAS analysis and the many potential sources of trace levels of PFAS, field personnel are advised to err on the side of caution by strictly following these protocols, frequently replacing nitrile gloves, and rinsing field equipment to help mitigate the potential for false detections of PFAS. Other specific items related to field sampling for PFAS are discussed in the sections below.

This document does not address water quality parameter measurements (e.g., specific conductivity, temperature, pH, ORP), sample preservation/packaging, chain-of-custody forms, or laboratory analysis. SOPs for these are included in the Programmatic QAPP and the site-specific Health and Safety Plan (HASP), as appropriate.

3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have completed and will have current health and safety training as required by Arcadis, the client, or regulations, such as 40-hour HAZWOPER training and/or OSHA HAZWOPER site supervisor training. Arcadis personnel will also have current training as identified in the site-specific HASP which may include first aid, cardiopulmonary resuscitation (CPR), Blood Borne Pathogens (BBP) as needed. The HASP will also identify any access control requirements.

Prior to mobilizing to the field, the sampling team will review and be thoroughly familiar with relevant site-specific documents including but not limited to the QAPP, HASP, historical information, and other relevant site documents.

Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and TGIs and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. Additionally, the groundwater sampling team will review and be thoroughly familiar with documentation provided by equipment manufacturers and become familiar with the operation of (i.e., hands-on experience) all equipment that will be used in the field prior to mobilization.

Ideally, Arcadis personnel directing, supervising, or leading groundwater sample collection activities will have a minimum of one (1) year of previous groundwater sampling experience. Field employees with less than six (6) months of experience will be accompanied by a supervisor (as described above) to ensure that proper sample collection techniques are employed.

4 EQUIPMENT LIST

The following equipment and materials must be available for sampling:

- Site plan of sampling locations, relevant work plan (or equivalent), and this TGI;
- Appropriate health and safety equipment, as specified in the site HASP;
- Dedicated plastic sheeting (preferably high-density polyethylene [HDPE]) or other clean surface to prevent sample contact with the surfaces;
- Conductivity/temperature/pH meter;
- Dissolved oxygen meter, oxidation reduction potential meter, and turbidity meter;
- Brushes for scrubbing sampling equipment;
- Pens and pencils for writing;
- Clipboards, field binders, and field note pages that are not waterproof;
- Labeled sample bottles:
    - Water: HDPE bottles fitted with polypropylene screw cap only; some types of PFAS samples (primarily drinking water) may require preservative, which will be indicated by the laboratory conducting the analysis. The laboratory will specify the sample bottle volume.
- Ziploc® bags to hold ice and samples;

- Appropriate blanks (field reagent blanks supplied by the laboratory);
- Appropriate transport bottles (coolers) with ice and appropriate labeling, no blue ice;
- Deionized water for initial decontamination rinsing;
- "PFAS-free" water provided by the laboratory for final decontamination rinsing;
- Packing and shipping materials;
- Groundwater Sampling Log; and
- Chain-of-Custody (COC) Forms.

5 CAUTIONS

5.1 Food Packaging

Some food packaging may be treated with PFAS-containing chemicals to prevent permeation of oil and water in the food outside of the packaging. To avoid potential food packaging-related PFAS contact:

- Do not bring any food outside of the field vehicles onsite and eat snacks and meals offsite.
- Wash hands after eating.
- Remove any field garments or outer layers prior to eating. Do not put them back on until done eating and hands are washed.

5.2 Field Gear

5.2.1 Clothing

Many types of clothing are treated with PFAS for stain and water resistance, in particular outdoor performance wear under brand names such as Gore-Tex®. To avoid potential clothing-related PFAS contact:

- Do not wear any outdoor performance wear that is water or stain resistant, or appears to be. Err on the side of caution.
- Wear pre-laundered (multiple washings, i.e. 6+) clothing that is not stain resistant or water proof.
- Natural fabrics such as cotton are preferred. Synthetic fabrics may also be acceptable if there is no indication on the label that the fabric is water and stain resistant.
- Most importantly, avoid contacting your clothing with sampling equipment, bottles, and samples.

5.2.2 Personal Protective Equipment

5.2.2.1 Safety Footwear

Some safety footwear has been treated to provide a degree of waterproofing and increased durability, and may represent a source of trace PFAS. For the health and safety of field personnel, footwear must be protected at all times to avoid potential PFAS contamination. To do this:

- Do not touch your safety footwear in the immediate vicinity of the sampling port (i.e., within 10 meters [m]).
- Do not allow gloves used for sampling to come in contact with safety footwear.

5.2.2.2 Nitrile Gloves

- Wear disposable nitrile gloves at all times. Don a new pair of nitrile gloves **before** the following activities at each sample location:
- Decontamination of re-usable sampling equipment;
- Contact with sample bottles or “PFAS-free” water bottles;
- Insertion of anything into the sample ports (e.g., HDPE tubing); and
- Handling of any quality assurance/quality control (QA/QC) samples including field blanks and equipment blanks.

Don a new pair of nitrile gloves after the following activities:

- Handling of any non-dedicated sampling equipment;
- Contact with contaminated surfaces; or
- When judged necessary by field personnel

5.3 Personal Hygiene

- Shower at night.
- Do not use personal care products after showering such as lotions, makeup, and perfumes, UNLESS medically necessary.
- Use sunscreen and insect repellent ONLY if necessary for health and safety. If they are necessary, apply sunscreen and repellant prior to initiating field sampling. If sunscreen and/or repellant need to be reapplied, ensure a safe distance away from the sampling locations and equipment (i.e., more than 10 m away). Wash hands after application.

5.4 Visitors

Visitors to the site are asked to remain at least 10 m from sampling areas.

6 HEALTH AND SAFETY CONSIDERATIONS

- Field activities must be performed in accordance with the site HASP, a copy of which will bepresent onsite during such activities.
- Work will be conducted on private properties, not under the control of Arcadis. Prior to conducting any work, the field crew shall develop a property-specific job hazard analysis that identifies any property-specific hazards (e.g., toys throughout lawn, unsafe stairs into property).

7 PROCEDURE

Arcadis staff will coordinate a sample date and time to sample the private well with the owner of the well. Unless otherwise specified, in writing, by the owner, all contact will be directly with the owner and not a property tenant. Upon arrival, Arcadis will provide introductions and let the resident/property owner know the purpose is to collect a potable well sample for PFAS analysis in accordance with previous correspondence provided to them regarding the sampling. Arcadis will request information from the property owner regarding the water system at each property. Information that will be recorded includes presence of water softeners, sediment traps, filters, etc., and the location of these items.

Additional activities to be performed and procedures to be followed by the sampling team prior to potable well sample collection include:

- Don a new set of nitrile gloves immediately prior to sampling.
- Do not use gloved hands to subsequently handle papers, pens, clothes, etc., before collecting samples.
- Use the 2-250 mL HDPE bottles that are supplied by the laboratory for each sample location.
- Samples bottle caps must remain on the bottle until immediately prior to sample collection, and the bottle must be sealed immediately after sample collection.
- Drinking Water Sampling Protocol: At each sampling location, the sampling team will wash and dry hands thoroughly with a clean towel prior to donning new non-powdered disposable nitrile gloves and then proceed to collect samples per the Army Guidance (A1 and A2) as below:
- The team will first remove any aerator, diffuser, tubing, splash guard, or any other fittings from the faucet to be sampled.
- The team will then flush the faucet at fast full flow for approximately 5 minutes, after which, they will reduce the tap water flow to a pencil-width stream.
- If the faucet or water source access point is for an infrequently used water source, the field team will ensure continuous purging of water for at least 15 minutes before reducing the flow to a pencil-width stream for sample collection.

- For sample collection, the field team will first check to make sure that each of the three 250-mL polypropylene sample containers include the preservative powder (Trizma). If a FTB is required to be collected at the location per the UFP-QAPP, the field team will also check that an FTB container filled with laboratory-prepared reagent water and an empty FTB bottle without any preservative are also available for that sample.
- The field team will then fill each sample container carefully to the bottom of the neck to avoid any overfilling and spillage of the preservative. The field team will make sure to not touch the inside of the polypropylene bottle caps or around the edge of the bottle during sample collection or allow them to encounter the faucet. The sample container will then be recapped, and inverted several times until the preservative is thoroughly mixed with the sample water. The same steps will be repeated to fill the other two field sample containers for the same sample location.
- The tap will be shut off after the sample collection.
- If a FTB is required, the field team will then proceed with opening the FTB container filled with laboratory-prepared reagent water and the empty FTB bottle, and pour the contents of the full FTB container into the empty FTB container.
- After sample collection, the team will label each sample container (including FTB, if applicable) using a pen or pencil with the sample ID, date and time of sample collection, installation name, sampler's name and other pertinent information.
- The field team will then place all sample containers from one sample location grouped together in a polyethylene bag in the sample cooler packed with double-bagged wet ice.
- The field team will then fill out the required forms provided in the field sampling documentation kit including sample collection forms and sample location notation forms.
- The field team will also note the relevant details associated with sample collection in their dedicated non-waterproof log books. At a minimum, they will note the names of sampling personnel, location where sample was collected, sample identification number or name, date and time when the sample was collected, descriptions of components removed prior to purging the tap, and any issues that occurred.

During Sample Collection

Potable water outfalls and taps are likely to vary. If possible, the team will avoid sampling from any taps fitted with Teflon tape or other PFAS-containing materials. Stainless steel and polyvinyl chloride materials are acceptable. The sampling team will collect unfiltered samples from a tap or port, as follows:

- Initiate flow from the water source and allow the system to flush for at least 3 minutes.
- Collect the sample into the HDPE bottle until the sample bottle is full (leaving slight headspace in the bottle is acceptable).
- Tightly screw on the polypropylene or HDPE cap.

After Sample Collection

Upon collection, the sample bottles will be placed in a sealed Ziploc® bag. Sample collection information will be recorded including the sample identification (ID) and time of sampling on the sample bottle label, in the field notes, and on the chain-of-custody (COC) form. The COC form will be explicitly marked for expedited analysis with a standard turnaround time (approximately 3 weeks). Samples will be placed in durable coolers, with enough ice to keep the sample temperature between 0 and 4ºC until delivered to the laboratory. Only "wet" ice will be used, with no use of "blue ice" or similar cold storage packets. PFAS sample coolers will be either delivered by Arcadis or laboratory courier to or shipped via FedEx Priority Overnight delivery to:

Sample Receiving
Eurofins Lancaster Laboratory Environmental
2425 New Holland Pike
Lancaster, Pennsylvania 17601

Samples will be analyzed for PFAS by U.S. EPA Method 537.1.

All disposable sampling materials will be treated as single use, and disposed appropriately after sampling at each location. Samples from each residence will be kept in their own dedicated cooler with the appropriate quality assurance samples.

8 WASTE MANAGEMENT

Typically, the tap water will be allowed to drain through the sink drain where the faucet is installed. If no sink drain below the tap water is available, the tap water will be collected in a disposable cup, and disposed via the closest drain.

9 DATA RECORDING AND MANAGEMENT

Following sample collection and shipping, the field team will demobilize back to the Arcadis local field office. The RTL and PM will organize a demobilization lessons-learned teleconference with the field team to capture any lessons that can be shared across the project with other field teams via a team SharePoint site. This will ensure continuous programmatic enhancement of field execution delivery to USAEC and USACE. The field team will draft a letter trip report to capture a summary of their field activities and any issues that they faced and will include a copy of their field forms as an appendix. The trip report will undergo internal review by RTL and PM, and will be submitted to Installation POC and USAEC.

Results letters will be provided to the well owners/users within approximately five weeks of sample collection, barring unforeseen delays in receipt of laboratory analytical results. If the combined PFOA/PFOS values at a well were below the HAL for past sampling events, but are above the HAL for future sampling events, then a phone call will be placed to the well owner/user within two days of completing the preliminary data quality review for the laboratory results for that sample.

10 QUALITY ASSURANCE

Avoiding cross-contamination from PFAS-containing materials during this sampling will be of utmost importance given the very low detection limits for the analyses that will be conducted for these compounds. As such, materials with the potential to contain PFAS will not be used during the sampling (including PTFE pipe tape, pipe thread pastes that contain PTFE, PTFE sample tubing, food wrappers, water resistant/proof clothing, waterproof field books, etc.)

Sample information, including sample ID and date/time collected, will be recorded on the provided bottle labels and attached to the sample bottles immediately after sealing the bottles. This information also will be recorded on the COC form provided by the laboratory, in a Potable Water Supply Sample Log, and in the sampling team's field notes. A signed copy of the COC form will be provided to the laboratory whenever a sample cooler is delivered to the laboratory. A copy of each COC form will be kept with the field notes and sample logs.

After receipt from the laboratory, Arcadis will conduct a preliminary data quality review (Level 2 data validation). The sample results will be communicated to well owners/users after completion of the preliminary data quality review, as outlined in the "Project Communication" section below. After completion of the preliminary data quality review, Arcadis will conduct a more comprehensive validation of the data (Level 4 data validation). The timeframe for the Level 4 validation may vary based on the amount of time required for the laboratory to send additional Quality Assurance/Quality Control information to Arcadis, and the number of samples under review. The anticipated timeframe for completion of Level 4 validation is approximately 8 weeks after sample collection, assuming timely delivery of results from the laboratory. If any changes to the reported sampling results become necessary after completion of the Level 4 validation, the well owners/users, PICA, USACE, USAEC, NJDEP, and EPA will be notified of those changes.

11 REFERENCES

U.S. Army Corps of Engineers – Omaha District. 2016. Chemistry Requirements – PFAS.

U.S. Environmental Protection Agency. 2009. USEPA Method 537: Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS), version 1.1, September. National Exposure Research Laboratory, Office of Research and Development.

Transport Canada. February 2016, Per-and Polyfluorinated Alkyl Substances (PFAS) Field Sampling Guidance.

United States Environmental Protection Agency (USEPA). 2013. Operating Procedure: Potable Water Supply Sampling. USEPA Region 4 Science and Ecosystem Support Division, Athens, Georgia (May 30, 2013) SESDPROC-3050R3.

12 ATTACHMENTS

Attachment A - Example Right-of-Entry (Missing)

Attachment B – Private Well Sampling Log

Attachment C - Example Private Well Questionnaire

ATTACHMENT A

Example Right-of-Entry

ATTACHMENT B

Private Well Sampling Log

ARCADIS Design & Consultancy for natural and built assets

Private Well Sampling Log

Sampling Personnel: _____ Date: _____

Purge Time: Begin:_____ End: _____ Weather: _____

Sampling Location Address: _____

Sampling Location (i.e., before/after treatment system. Inside tap, outside tap, etc. _____

_____

Sketch of Sample Location and Specific Site Features

Is there a water softener upstream of the sampling location? _____

Are there any other wells on the property? _____

Approximate Flow Rate During Sampling: _____

How was the Flow Rate Measured? _____

Gallons Purged (Estimate): _____

Purge water Observations (Color, Odor, etc.): _____

_____

Constituents, No of Containers, Container Type, and Preservative: _____

_____

Sample ID: _____

QA/QC or Duplicate Sample Collected at this Location? _____

Other Observations On-Property (basement, septic tank, work shop, signs of spills or disposal area, etc.)

_____

Other Observations Off-Property (locations and names of the following within close proximity to property; gas stations, automobile repair shops, car washes and any industrial property)

_____

_____

Sample Team Lead Signature: _____

ATTACHMENT C

Example Private Well Questionnaire

PRIVATE WELL QUESTIONAIRE

United States Army Corps of Engineers, New York District

Picatinny Arsenal

Property Owner Name(s):	
Street Address:	
City/State/Zip:	
Mailing Address: (leave blank if the same as above)	
Phone:	Email:

Is this rental a unit? (Please circle) YES NO

If rental, please provide the following:

- Owner Name:
- Owner Phone:
- Tenant Name:
- Tenant Phone:

Number of Occupants:

Depth of Well (in feet):

Do you use your well for drinking water? (Please circle) YES NO

Do you treat your water? (Please circle) YES NO

If YES: (Please circle) Water Softener
Carbon Filtration Unit
Reverse Osmosis
Other (Please specify):

If YES, can the treatment unit be bypassed to collect an untreated sample? (Please circle) YES NO

Does your property have a septic tank? (Please circle) YES NO

If YES, please indicate where the septic tank is located on the property.

Has your well been previously tested for PFAS? (Please circle) YES NO (If YES, please provide a copy of the test results.
To help expedite scheduling, please indicate if we may use an outdoor spigot to collect a water sample during business hours. (Please circle) YES NO
Thank you for taking the time to fill out this form. Kindly return it to our office in the enclosed self-addressed stamped envelope at your earliest convenience. Please use the back of this form for any additional contact information or details about your well.

ARCADIS Design & Consultancy for natural and built assets

Attachment 5

Example Off-Site Property Owner Letters

DEPARTMENT OF THE ARMY
INSTALLATION MANAGEMENT COMMAND
HEADQUARTERS, UNITED STATES ARMY GARRISON
PICATINNY ARSENAL, NEW JERSEY 07806-5000

REPLY TO
ATTENTION OF

Month, XX, 2019

Mr./Mrs. John Doe
123 Main Street
Nowhere, NJ 12345

RE: Property Address (Block # Lot #)

Dear Property Owner or Current Resident:

The purpose of this letter is to confirm that you use a private water supply well to provide your drinking water to the above referenced property in Rockaway Township New Jersey and to ask you to complete the enclosed Private Well Questionnaire. Representatives from our Army contractor, Arcadis, may have, or will soon be contacting you to either schedule a sampling event or to follow through if you have not completed or sent the questionnaire.

In February 2018, Picatinny Arsenal discovered the combined levels of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) above the U.S. Environmental Protection Agency (USEPA) lifetime health advisory level (HAL) level of 70 parts-per-trillion in our drinking water.

For a more detailed background, please see the enclosed Picatinny PFOA/PFOS Assessment Fact Sheet.

PFOS and PFOA are part of a class of manmade chemicals known as perfluorinated compounds. PFOS and PFOA are found in many consumer and industrial products. For more information on PFOS/PFOA, please see the enclosed fact sheet from the USEPA.

As part of the Army's effort to determine whether these compounds may have migrated to water wells outside of Picatinny, monitoring wells near Picatinny Arsenal's southern boundary were sampled. Three wells were found to have PFOS/PFOA levels above the USEPA HAL.

We now need to determine if drinking water from wells that are immediately down stream of Picatinny have PFOS/PFOA above the HAL.

To accomplish this task, we ask for your assistance in completing the enclosed "Private Well Questionnaire." Please fill it out to the best of your ability and return it in the self-addressed stamped envelope provided. This information will greatly assist us in developing an organized sampling strategy for the area.

You will not be responsible for any costs associated with the collection and analysis of water samples at your property. When laboratory analysis is complete, we will furnish you the PFOS and PFOA results. The results will also be provided to your local health department, USEPA and the New Jersey Department of Environmental Protection.

If you should have any questions regarding any of the above, including the enclosed Fact Sheet, please contact either Ted Gabel, 973-724-6748 (ted.b.gabel.civ@mail.mil) or Timothy Rider, 973-724-6364 (timothy.l.rider3.civ@mail.mil).

If you have specific questions, regarding the questionnaire or sampling, you can contact Lisa Szegedi from Arcadis at 201-398-4328 (Lisa.Szegedi@arcadis.com).

Your cooperation and assistance is greatly appreciated.

Sincerely,

Ted Gabel
Project Manager for Environmental Restoration
Picatinny Arsenal

PRIVATE WELL QUESTIONAIRE
Picatinny Arsenal

Property Owner Name(s):

Street Address:

City/State/Zip:

Mailing Address:
(leave blank if the same as above)

Phone:	Email:

1. **Please confirm that you have a drinking water well on your Property:**
2. **Does the Army have your permission to sample your drinking water supply well?**

Is this rental a unit? (Please circle) YES NO
If rental, please provide the following:

- Owner Name:
- Owner Phone:
- Tenant Name:
- Tenant Phone:

Number of Occupants:

Depth of Well (in feet):

Do you use your well for drinking water? (Please circle) YES NO

Do you treat your water? (Please circle) YES NO

If YES: (Please circle) Water Softener
Carbon Filtration Unit
Reverse Osmosis
Other (Please specify):

If YES, can the treatment unit be bypassed to collect an untreated sample? (Please circle) YES NO

Does your property have a septic tank? (Please circle) YES NO
If YES, please indicate where the septic tank is located on the property.

Has your well been previously tested for PFAS? (Please circle) YES NO
(If YES, please provide a copy of the test results.

To help expedite scheduling, please indicate if we may use an outdoor spigot to collect a water sample during business hours. (Please circle) YES NO

Sample Permission: by signing below you authorize the Army and its contractor, Arcadis, to sample your drinking water well. You will be contacted within 10 business days to make arrangements for the sampling. Please note, on average, sampling your well should take **less than 30-minutes** depending on storage tank capacity and/or connected water treatment unit, and the sampling will be performed at no cost to you.

_____

Signature/Date (owner/resident)

_____

Signature/Date (resident, if different than owner)

Thank you for taking the time to fill out this form. Kindly return it to our office in the enclosed self-addressed stamped envelope as soon as you can. Representatives from our Army contractor, Arcadis, will soon be contacting you to either schedule a sampling event or to follow through if you have not completed or sent the questionnaire.

Please use the back of this form for any additional contact information or details about your well.